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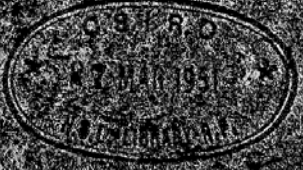
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LW/AWH MK I

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COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH

RADIOPHYSICS LABORATORY

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LW/AWH MARK I - TECHNICAL DESCRIPTION

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JHG/MPH

September, 1944

A B S T R A C T

LW/AWH Mk.I is the modification of the LW/AW equipment to permit heights to be obtained as well as range and bearing.

In performance, this set gives heights between 2° and 20° angle of sight to ranges out to 70 miles for a twin engined medium bomber. The warning range is at least the normal AW performance.

This report is in three sections. The first gives a general description of the double beam method used, of the equipment to carry out this method and the general performance and tactical use of the equipment.

The second section gives the information necessary for the operation of the equipment.

The third section gives technical information necessary for installation, testing and maintenance of the equipment. The aerial section is not covered completely as the N.S.W.G. Railways, the makers, will supply a special handbook for this.

.....*H. J. Brown*.....Head of Section
(H.J. Brown)

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I GENERAL DESCRIPTION

1.0 Introduction

To satisfy an operational requirement in the S.W.P.A. for height finding of aircraft at all heights up to 35,000 ft. and at all ranges up to 100 miles, the LW/AWH set was produced.

This equipment, which is a modification of the existing LW/AW set is intended to provide heights to $\pm 2500'$ in most of this region, as well as performing the normal LW/AW function of providing warning range and bearing.

The main features of this equipment are:-

- 1) built in the LW/AW form (although larger) it is air transportable with an erection time about twice that of the LW/AW.
- 2) the performance is height independent. It is also site independent over sea, the usual site for AW stations and should not be greatly affected over most types of land.
- 3) the size of the array, 20' x 15' and the complexity of the feeder and switching system are both reasonable, although greater than the LW/AW.
- 4) scanning by this radar is similar to LW/AW and does not require any "putter on".

1.1 Method

The set used consists of a normal AW radar set with minor additions provided with a rather more elaborate aerial system. This aerial system is arranged so that it can be rapidly switched to give a beam which is either broad or narrow in the vertical plane. The system was first described in connection with a suggested British Naval 10cm. R.D.F. set (A.S.R.L. London Report No. 311).

Referring to Dwg. D6330, two aerial arrays pointing in the same direction are situated at O. The aerial diagrams in the vertical plane of these two arrays are indicated by two curves $F_1(\theta)$ and $F_2(\theta)$. If we assume, for the moment, that no reflection takes place from the ground, then the echo responses from an aircraft will be OA and OB for the two arrays $F_1(\theta)$ and $F_2(\theta)$ respectively. It is evident that the angle of elevation θ of the aircraft above the horizontal can be estimated directly from the ratio OA:OB providing the aerial polar diagrams are known.

In practice, an earth reflected radar beam OA'B' will pass to and from the aircraft and the signals obtained in the receiver will be determined by the vector sums of the signals from the two paths. The actual ratio of the strengths obtained in free space is $(\frac{OA}{OB})^2$ i. the same arrays are used for transmission and reception. Taking account of the earth reflected ray, the ratio will be -

$$\left(\frac{OA + OA'}{OB} \right)^2$$

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the additions being vector additions in each case. If the two arrays are the same height above the earth and the angle of elevation to the aircraft is small, then it is sufficiently accurate to assume $\theta = \phi$, in which case $OA/OB = OA'/OB'$, and the earth reflected ray does not change the signal strength ratio as measured in free space.

Under conditions of operation of the set, the earth reflected ray will normally introduce very little error, although of course, it results in the usual formation of the multiple lobe vertical polar diagram.

In applying this technique in practice, a mechanical capacity switch changes the aerial polar diagram at a rapid rate and simultaneous observations are made on the viewing oscilloscope of the echoes obtained from the two array diagrams. The ratio of these ratios is then measured by bringing them to equality with a calibrated attenuator.

1.2 Description of Equipment

The block schematic Dwg.G6629 shows the basic elements of the gear used to accomplish the double beam system of heighting.

1.21 Aerial

The aerial (Plate 1) is an 8 x 8 broadside array (consisting of four LW/GCI bays placed one upon the other) making the height of the array, 20' or double that of the LW/AW. One vertical twin wire feeder connects the inner two bays and another vertical twin wire feeder connects the outer two bays. (see Dwg.B6748).

When the inner two bays are fed, the broad vertical diagram is obtained, with a first minimum at 30° . When all bays are fed, the narrow diagram is fed, with a first minimum at 14° . It should be noted, since the power gain when all elements are used is double that when half the elements are used, the ratio of signal strengths obtained for an aircraft at zero angle of elevation is 2:1. Dwg.G8442 shows the vertical polar diagrams for the broad and narrow diagrams whilst Dwg.G8441 the curve, echo ratio versus angle of elevation. Due to loss of signal strength above 10° and loss of accuracy below 2° , height finding is restricted to the region between 2° and 10° .

To increase the high angle coverage, antiphase working is also provided. Four phasing switches mounted in the aerial feeder system provide for an increase in feeder length of $\lambda/2$ for each of the two upper bays in a manner similar to the usual GCI system. With this working the top two bays are fed out of phase with regard to the bottom two phase resulting in vertical polar diagrams for the broad and narrow cases as shown in Dwg.G8442. Dwg.G8441 shows the ratio curve for echo response. This antiphase working is used between 10° and 20° of elevation.

1.22 Beam Switching Unit

The means of rapidly switching the aerial diagram from broad to narrow is the Beam Switcher. The two vertical twin wire feeders pass down the mast into the hut and are changed to

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two coaxial feeders by trombone $\lambda/2$ transformers. These two coaxial feeders, labelled respectively Inner and Outer pass into the Beam Switcher which is in the form of a rotary capacity switch. By its action, the capacity switch connects the Inner feeder alone for half of a cycle to the radar equipment and then for the other half, connects and matches both inner and outer feeders. With the capacity plates over towards C, (Dwg.C6629) the resultant capacity at C plus the length of feeder CA places an R.F. short at A. With the length AB a quarter wave, this means that no power will flow along to the outer, but all along the inner. The reactance at D is adjusted to an open circuit value so the main feed line is matched to the inner feeder. With the condenser plates in the opposite position, the value of L_o and length AE are arranged so that there is an open circuit across the line at O and so power flows equally to both inner and outer feeders. To match the main feeder to these two feeders, the length DB and reactance at D are adjusted.

The motor driving this ^{is} a 1500 r.p.m. synchronous type and so alternate pulses from the 50 c/s p.r.f. transmitter are fed to the inner and then both inner and outer respectively.

1.23 Radar Set

A standard AW Mk.IA radar set is used. This provides 15 KW of power in 20 μ s pulses at 50 p.r.f. (synchronised from the power supply). A concentric type T.R. switch is used and a preamplifier (double RL37) added to the receiver.

A side by side display of the two sets of echoes obtained with the two aerial systems is obtained by using magnetic deflection of the time base pattern for one position of the beam switcher. This is done by means of a cam and contacts on the switch itself and a pair of deflecting coils on the oscilloscope.

To obtain the ratio between the heights of the two echoes, a system of differential attenuation is used. By rotating a dial to the right, the right hand echo as displayed can be attenuated until the echoes are equal. If the left hand echo is the larger, it can be attenuated until they are equal by turning the dial to the left. A calibration of the attenuation can be taken giving a definite ratio for any dial setting. The actual attenuation of the echo, as indicated schematically in Dwg.C6629, is obtained by applying a variable bias on the second R.F. tube of the pre amplifier, by means of a regulated D.C. supply and potentiometer. This bias is only switched on to the valve by another cam and set of contacts on the beam switch, when the capacity plates are in the position corresponding to the ratio dial setting, left or right.

A stroboscope is incorporated in the display so that when height finding is being done, only a small part of the time base is shown. This results in the two echoes being

seen side by side with the time base associated with one echo being blacked out with regard to the other echo. Thus the noise associated with one echo does not interfere with that of the other.

Photo 2 shows the receiver side of the operating tent and Photo 3 shows the transmitter side of the operating tent. Photo 4 shows a pair of echoes as seen when height finding, before and after levelling.

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1.3 Performance

Dwg.D6853 shows the coverage diagram for the aerial situated 250' above the sea (as at Bondi). The envelopes drawn are for a 2:1 echo and it is seen that the accurate height finding region is from 10 to 70 miles in depth and from 2° to 10° , for the phase working of the angle. With the aerial working in the antiphase position, the height finding region is from 10° to 20° in elevation and from 10 to 40 miles.

The use of this equipment over sea will be the normal procedure, but it may be used on a high cliff overlooking a valley or on a flat site similar to GCI. For the latter case, the coverage diagram Dwg.D8440 is given.

Report No. T.I.101/4 gives typical performance results on test flights at Bondi at heights from 5000' to 30,000'. It is seen that the results generally are within the $\pm 2500'$ in the region 2° to 20° .

1.4 Tactical Use

The main tactical use of this equipment is to provide warning heights as well as range and bearing for coastal sites overlooking the sea.

The siting requirement, at the moment, for heighting is that the angle of depression from the centre of the array to the sea should be greater than 20° .

One of the main uses will be to replace existing AW stations at coastal sites. They can also be placed in suitable forward areas provided the increased time of installation compared with the LW/AW equipment is realised.

The actual tune of installation should be approximately double that of the LW/AW equipment, whilst in transportability it should be equal, except in its being a slightly larger station.

For use inland, it should be workable when sited on a level stretch of ground, equivalent to a GCI site or else on a high cliff overlooking a long valley.

It is more frequency selective than the LW/AW being only operable over the band $200 \pm \frac{1}{2}$ Mc/s. Provision has been made for keeping this station on its working frequency without trouble by the use of an echo box.

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II OPERATION

2.0 Introduction

This section is devoted to a description of the suggested operation of the station in the light of experience at Bondi. It will deal mainly with the procedure special to the LW/AWH as distinct from the LW/AW set.

2.1 Switching On

This is the same as the normal LW/AW except for three additional switches on the Gain Control Panel. These are Beam Switching Motor, Phase-Antiphase, and Search-Height.

The Beam Switching Motor runs continuously and is switched on with the other switches when the station is "put on the air". This is a synchronous motor and does not always come into synchronism, on switching on. This condition of "unsynch" causes a very noticeable hunting sound and not the even note of synchronism. By switching off and then on again quickly, the motor can be brought into correct operation. Another difficulty is that the motor can synchronize in one of two positions in relation to the transmitter pulse. The correct one is when the condenser plates mesh evenly in fixed plates whilst the wrong one is 90° away, in which the condenser plates are half in and out, an inoperable position. This latter case can be detected by the unsteady appearance of fixed echoes and wrong operation of ratio dial. The simplest cure is to switch off and on the time base switch until the echoes are steady as the 50 c/s Multi controlling the transmitter pulse can also be phased in one of two positions.

The other two switches are only used when heighting and whilst searching are switched to "Phase" and "Search" respectively.

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2.2 Heighting

The LW/AWH gear requires an extra operator to the normal LW/AW crew. This is to perform the function of heighting.

Thus we have the four operators with their appropriate duties:-

- 1) Ranger - maximises for bearing, ranges, levels for ratio, and estimates sig. to noise.
- 2) Heighter - records range, ratio (either phase or antiphase), sig/noise. Then uses range and ratio to obtain height from height range chart. Passes height to plotting room.
- 3) Plotter - hears range come through and sees bearing on remote bearing indicator and then obtains grid reference, passing this to Reporter.
- 4) Reporter - (is ordinary operator if land line connection to Fighter Section or W/T operator if in contact by W/T or R/T.) Records grid reference and height and passes this to Fighter Sector.

The Ranger and Heighter sit alongside one another in the operating tent and are connected by phone to one another and the plotting tent.

A loudspeaker in the plotting tent conveys messages from the operating hut to the Plotter and Reporter whilst the Reporter has a voice piece to talk back to the operating tent.

The ranger's job is the most important one and requires some hours experience before becoming facile and skilful with the technique. The heighter's job is similar to the plotters only easier.

2.31 Hints for the Ranger

- (a) You have to maximise quickly for bearing - run through maximum quickly until blip noticeably decreases then quickly return to judged maximum. This is done whilst on search. Once having made a few plots, it is often possible to maximise for bearing whilst the echo strength is low (i.e. near minima) and then switch to "Height" and wait for the echo strength to increase to a working levelling value. This, of course should only be done if aircrafts' course is in your direction.
- (b) Having maximised, the echo is brought to the hair line to obtain range. Then if the echo strength is above 1/1 sig/noise, switch to "Height" and try and obtain ratio by equalising the two echoes. Turning the ratio dial to readings above 65 reduces the right hand echo alone whilst a position below 65 reduces only the left hand echo. Sig/noise is estimated on the weaker of the two echoes (i.e. on the unattenuated signal). When the signal is weaker than 2/1 the ratio must be mentioned as being 3rd class. If the echoes' strength is not sufficient to obtain a ratio then record the plot as "search".
- (c) In regions of minima any slight errors in the propagation system tend to be accentuated and so ratios should be obtained

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when signals have risen to full strength. At the same time, the more height ratios obtained the better.

(d) Remember to concentrate more on getting the ratio than on making sure of the range. The range can be nearly adjusted a little later when the echo is weak.

(e) Normally, operate on "Phase" and call all ratios obtained with this working "black" as "black 85" etc. Only operate on "Anti/Phase" if the A/C you have been tracking has passed into that region or you have reason to believe there is something there. Ratios obtained in "Anti/Phase" are called "red" as "red 85" etc. Phase working covers 0 to 10° angle or sight and Anti/Phase working 10° to 20°. Thus Phase working covers out to the farthest warning range whilst the Anti Phase is for close in, high flying, craft. Have a good look at the height range chart and appreciate the various regions.

2.32 Hints for the Heighter

(a) As accuracy improves with number of plots, normally take average of three height plots and then send this height in as the height of the A/C. If this is delaying information unduly, then send in height from a single plot as "3rd Class", i.e., not to be relied on too much.

(b) Plots in the region 0 to 2°, due to the insensitivity of the ratio in this region, must be sent in as "3rd Class".

2.4 Typical Operation

A sample of normal operation would be as follows -

A (Ranger) is searching (sweeping over his operational arc). Picks up target. Maximises for bearing. Ranges. Calls out: "Plot No.3. 130 miles". Switches on I.F.F. No response. Calls "No cockerel". Switches from Search to Height. Echoes too weak for levelling, sig/noise 1/1. Calls "Search 1/1". Switches off I.F.F. and continues on search, after taking a quick look at bearing.

B (Heighter) has recorded all this information except "No cockerel"

C (Plotter) has noted the bearing on the remote bearing indicator when A said "Plot No.3" and on hearing range 130 miles works out grid reference and then calls to D(Reporter) "Plot No. 3 Queen Roger 6553".

D(reporter) has recorded Plot No.3, range bearing, no cockerel, grid reference and time. He now calls to Fighter Sector, "Plot No.3 Queen Roger 6553 No cockerel, no height".

A continues on his search, obtaining fresh plots each time he passes through the direction of plot No.3. Suppose the target has now reached heighting range.

A has maximised and ranged. Calls "Plot No.3, 65 miles". Switches from Search to Height. Obtains height ratio. Calls "Black 82. 4 to 1".

This last denotes sig/noise ratio.

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B has recorded this information and now plots this ratio and range information on his height range chart. A, meanwhile, obtains two more plots which B also records and plots. B then takes an average of the three height plots and calls -
"Plot No.3 62 miles 22,000 ft."

C has noted the bearing and ranges of these three plots of A and has obtained an average grid reference calling to D
"Plot No.3 Queen Sugar 6411"

D has recorded Plot No.3 Range, bearing and grid reference and height and now calls to Fighter Sector -
"Plot No.3 Queen Ribert 6411 22,000".

After his three plots, A continues on his search unless requested by F/S through D to stay on Plot No.3.

If when A passing through the bearing of plot No.3 in his search, he can no longer obtain height ratios on Phase then he switches to Anti/Phase. Then he would call
"Plot No.3 15 miles Red 92 3 to 1".

B records and plots as before. As anti phase working is for ranges below 35 miles, stronger signals and more accurate ones are usually obtained and B need not wait for three plots and can send the height through from the one plot. C and D perform as before.

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III TECHNICAL

3.0 Introduction

This section gives detailed information on the components special to LW/AWH in regard to circuits, testing, installation and maintenance and is written up for the personnel who set up and run a station.

As regards the aerial and hut only their electrical details are dealt with in detail as the N.S.W.G. Railways will be dealing with the mechanical and wiring details.

3.1 Detailed Description of Components

3.11 Aerial and Feeders

Dwg. B6748 is a schematic of the aerial and feeder system. The aerial consists of four LW/GCI type bays, each containing 8 x 2 elements, mounted one upon the other, making an aerial 8 x 8. In transit the aerial is broken down into 8 panels and on erection, four panels are put together on the mast to form the lower unit and the other four are put together to form the upper unit.

The four sections of each bay are fed by a horizontal 330 ohm feeder ($\frac{1}{4}$ " dia twin copper tubes) equally in phase and amplitude. With this system the impedance at the centre of the horizontal feeder is approximately $600 \Omega // -j 300 \Omega$

The two outer bays (the top and the bottom one) are connected to a vertical feeder by two short feeders of equal length coming from the centre of the horizontal feeder of each bay, marked A and B. One stub on each of these short feeders provides for matching to the 330 Ω impedance of the feeder.

The two inner bays join similarly to another vertical feeder.

Another two vertical feeders provide connection to the equipment in the tent below. These feeders each join the appropriate vertical feeder mentioned above by a quarter wave length of horizontal feeder of $Z_0 = 220 \Omega$ so that each feeder is rematched along the length of line passing into the hut. Thus of the two feeders passing to the hut, one called the Outer, feeds the two outer bays and the other, the Inner feeds the two inner bays.

No mention has yet been made of the four phasing switches also shown on the Drawing. Two of these switches are in the Inner feed system and two in the Outer feeder system and their function is to change the electrical length of the feed going to the top two bays by $\lambda/2$ thus making the top two bays out of phase with regard to the bottom two bays.

Looking at the Outer feed system in detail, ab, cd, ce, ef, fg, ah, and hd are each $\lambda/4$ lengths whilst bc and dg are $\lambda/2$ lengths. When the switch below in the hut is on

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"Phase" a current energises the relay in the phasing switch at e, placing an open circuit across the line at e and de-energises the relay at g, placing a short at g. Now a short at g also means a short at d since gd is $\lambda/2$, and hence with a short at g and d, there will be an open circuit across the line at c and f, and so no power will flow around c, d, g and f and all will flow along bcef to g. Also if the electrical lengths to each of the outer bays from b and f respectively are the same, then the difference in electrical length from b to each of the outer bays will be bf or λ and so each bay will be fed in phase.

Now with the switch in "Antiphase" phasing switch at g is energised placing an open circuit at g and phasing switch at e is de-energised placing a short at e. Thus all the power will now flow around cdg to f and none along cef. The difference in these paths is $cd + fg$ which is $\lambda/2$ and so now the two outer bays are fed out of phase.

The two switches in the Inner feed system are arranged similarly and so when the switch below is on "Phase" all bays are fed equalling in phase and when in "Antiphase" the top two bays are fed out of phase in relation to the bottom two bays.

The horizontal polar diagram is shown in Dwg.G8443 whilst the vertical polar diagrams - Phase and Antiphase - are shown in G8442.

A monitoring dipole is mounted on the top of the lowest bay to pick up a fraction of the aerial output and is fed down below by a hose covered UR1 cable.

The Interrogator and Reponder aeriels (light Yagis) for the BL4 equipment are mounted at the sides of the array as shown in Plate 1.

3.12 Beam Switcher

Dwg.B6985 is an assembly of this unit but its action is seen more clearly from the Schematic Dwg.C6629.

The two vertical feeders passing down into the hut are transformed into coaxial feeders by means of $\lambda/2$ trombone transformers. The tapping position and shorting bar position are adjusted on the vertical feeders so that each coaxial feeder is accurately matched to 75Ω , the Z_0 of the cable. These coaxial feeders, the Inner and Outer, pass then into the Beam Switcher.

The action of this unit is by means of a capacity switch to connect for one position, only the Inner feeder to the Radar equipment and for the other position to connect both Inner and Outer feeders equally and at the same time keeping the input to the unit matched.

This is done as follows - with the capacity plates on the right hand side or "Narrow", there is a net inductive reactance of value $+j 150\Omega$ at C, due to the variable shorted length of line L_0 . This can be regarded as an equivalent length of shorted line of 63° and thus with length of line $CA = 63^\circ$.

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makes a shorted length of line equal to 126° . The shorted length $AE = 54^\circ$ tunes this to a $\lambda/2$ length of line, shorted at each end and thus places an open circuit across A. Thus the Outer feeder remains matched up to B and the power coming along DA will be divided equally between the Inner and the Outer.

With the capacity plates on the left hand side or "Broad" there is a net capacitive reactance of $-j150\Omega$. This is equivalent to an open circuited line of length 27° and this with the length of line $CA = 63^\circ$ makes a $\lambda/4$ length of open circuited line. Thus a short is placed across the outer feeder and so all the power will flow in the inner. Also since AB is $\lambda/4$, the inner feeder remains matched to 75Ω , as BD is a variable line of $Z_0 = 75\Omega$.

As regards the other side at D, with the capacity plates on the left hand side, the variable shorted line L_T is adjusted to give an open circuit across the line and so the input to the unit is 75Ω , and all power flows into the inner.

With the capacity plates on the right hand side, there is a capacitive reactance across the line equal to $-j105$ and this with the variable line BD equal to 35° rematches the $75/2$ impedance at B due to both the inner and the outer feeders, back to 75Ω .

Thus with the capacity plates in the right hand side (or Broad) the input impedance is 75Ω and all power flows into the Inner feeder (and thence to the inner bays) while with the plates in the left hand side (or narrow) the input impedance is still 75Ω but the power is equally divided between the Inner and Outer feeders.

Two cams are mounted on the same shaft as the capacity plates. The one further from the motor actuates the differential RF attenuation system and the one nearer the motor actuates the magnetic deflection. A 240 V 1500 rpm synchronous motor provides the rotation for the system.

3.13 Preamplifier

This is unit mounted on the Receiver tray (Circuit Dwg. D7671). It not only increases the sensitivity of the Receiver by about 4 db (which is handy but not essential) but also performs the job of RF variable attenuation.

The actual preamplifier is of a standard type using two RL 37's and there are three tuning condensers which require aligning in similar fashion to the Aerial RF, etc. controls on the Receiver. The supply necessary is 250-300 V D.C. and 6.3 V A.C., both of which come from the Receiver unit.

The RF attenuation is accomplished by applying a variable positive bias to the cathode of the second RL37 valve. With the bias at 0 (i.e., earthed) the tube operates in normal fashion and the gain of the tube is regarded as 0 db. With increasing values of bias, the output decreases until with

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about + 7 volts, a maximum attenuation of about 35 db. is obtained over the normal gain. In practice a potentiometer in the gain control panel, operating from a supply of about 4.5V provides an operating region of attenuation of from 0 to 20 db.

3.14 Modifications to Viewing Unit (Circuit Dwg. C7241)

3.141 - Deflecting Coils, L1.

This is a standard system of two horizontal coils mounted above and below the oscilloscope which when a current of about 50 mA flows deflects the pattern about 3/8" to the left. The current supply for this is obtained from the earthy side of the Receiver and Time Base Power Supply (Dwg. P8459) and is adjustable by resistor R2 (Dwg. D7047). By means of one of the cam and contacts on the Beam Switcher the current only flows through the coils when the condenser plates are in the Broad position and thus the deflected time base is the Broad Set. In the Narrow position the current is transferred to resistor R1 (Dwg. D7047) thus providing a steady drain from the power supply.

3.142 - Strobe and Regulated Voltage Supply

This is a separate unit mounted upon the Viewing Unit (Circuit Dwg. D6841).

The strobe action is to apply a positive pulse of about 40 μ s. duration to the oscilloscope grid at a time along the Time Base corresponding to the Range Dial setting. Thus the picture obtained will be a brightening in of about four miles of time base starting from the hair line at the centre of the tube. With the deflection of the Broad time base, the actual picture is two narrow sections of time base side by side, the right hand one starting at the hair line.

To accomplish this, the output of the positive going time base amplifier tube V7, is applied to the first of two amplifier tubes, 6AC7's. Normally when the electron beam of the time base is passing through the centre of the screen (i.e. hair line) both grid voltages of the TB amplifier tubes are equal and also both plate voltages. That is, there is an equal drop through their plate loads. Also at this time, this equal plate voltage is round about 0 volts, (or earth). Thus the output from V7 is a sharply rising voltage which passes through earth at about the same time as the T.B. is passing through the hairline. Thus the output of the first strobe amplifier is a negative pulse which starts at about the same time as the T.B. is passing through the hairline. To permit of accurate timing (or positioning) a potentiometer P80 is added to the plate load of V7 which allows a variation in the time when the output is passing through earth.

By means of a clipping circuit C2 and R5, in the output of V1 of the strobe, a negative pulse of 40 μ s. is obtained. This is further squared and amplified in V2 (this latter being at 0 bias so that the positive pulses are not amplified) and then applied to the grid of the oscilloscope by R10 and C3.

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As the strobe is only required when heighting, a bias network R11 and R12, connected to the cathode of V2 cuts off the strobe when searching. On "Height" the control lead is earthed, thus earthing the cathode and allowing the strobe to operate. So that the intensity level remains unaltered on switching from "Search" to "Height", the white in is effectively wiped out by condenser C33. This is floating in "Search" but is connected to earth in "Height" thus greatly reducing the white in voltage. For this the normal grid coupling resistor had to be replaced by two R90 and R91.

As well on the strobe unit is a voltage regulating tube VR/150 which together with its resistors R6, R8 and R13 provide the +4.5 Volts for the R.F. attenuation system.

3.143 Other Modifications to Viewing Unit

Minor modifications to the circuit were a rearrangement of the auxiliary focus control circuit R68 and an alteration of the vertical deflection for the BL4 operation (R86 and R87).

3.15 Gain Control Panel (Circuit Dwg. D7047)

R7 is a stud potentiometer which provides the variable bias for the R.F. attenuation system. An earthing slip ring on its shaft provides for shorting out the bias when the condenser plates are on "Broad" and the potentiometer is turned past midway to the right (i.e., for readings on the dial greater than 65) and similarly shorting out the bias on "Narrow" when the potentiometer is turned past midway to the left (i.e., for readings below 65). Two sets of contacts on the beam switcher are also necessary for this. Thus, on heighting, only one of the two echoes is attenuated.

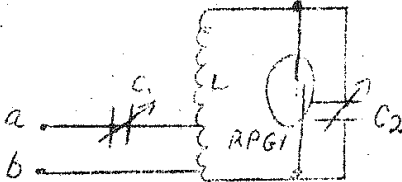
The switch S1 is the heighting control. When switched to "Search" the bias system, the deflection system and the strobe system are eliminated. Thus the trace on the oscilloscope is the normal AW one, except that two superimposed echoes are seen from every target. When switched to "Height", the bias, deflection and strobe systems are operative and the "white in" is shorted out. Thus what is seen on the screen is two sections of time base, side by side, either of which are under attenuation control. R2 provides for variation of the separation distance of these two time bases.

The switch S4, provides for switching of the 24V D.C. supply to either one of the two sets of phasing switches in the aerial. This 24V D.C. supply is obtained from a separate rectifier supply mounted on the rotating platform.

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3.16 T.R. Switch

This is the coaxial version of the open wire parallel feed type. Dwg. C2877 shows the assembly and each of the two units may be regarded as the equivalent circuit.



On transmitting, the RPGL is struck, resulting in a low impedance across the gap and the circuit is a series type, being resonated by condenser C1. The transformer action results in the voltage across the gap, about 200V, being reduced to about 20V across the line ab. Thus the screw driver adjustment C1 tunes for suppression.

On receiving, C1 is in series with a parallel resonant circuit, tuned by C2 and so the impedance across the line is very high, resulting in a loss in reception of less than $\frac{1}{4}$ db. The tuning adjustment then for reception is the knob control C2.

3.17 Test Gear

3.171 - Echo Box

This is both a selective wavemeter and a monitor for the overall A.W. set performance.

In principle it is a resonant $\lambda/4$ of high Q, (about 6000) provided with two terminals adjustable (pick up loops) to introduce and take out energy. Dwg. D6862 shows the assembly.

In use as a wavemeter, the R.F. is introduced into one of the terminals and the other terminal connected to a F.I. Receiver if CW or a peak diode voltmeter if pulse. As the bandwidth of the Echo Box is ± 40 Kc/s, it is a very selective device.

When used as a performance check, the monitoring dipole feeds into one of the terminals, thereby feeding energy in whilst the transmitter is pulsing. At the end of the transmitter pulse this energy is slowly radiated out by the monitoring dipole, a fraction being fed back to the AW receiver via the aerial pick up. Thus what is seen on the viewing unit trace is a long pulse, starting with the transmitter pulse and dying away into the noise at some range R miles. This range R, is a criterion of the set's performance, as the duration of the pulse depends on transmitter power output, aerial condition, and receiver sensitivity. In practice, after the whole set has been tuned up individually, the "ringing time" is determined as being so many miles and thereafter any decrease in this range means a corresponding fall in performance. In this test, the other terminal is left unconnected.

3.172 - Test Set A-18-1

Dwg. D8009 shows the modifications to the standard

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test set.

To provide for both positive and negative inputs, valves V1 and V2 and thus circuits have been converted to a "flip-flop" multivibrator. Small condensers have been included in the inputs so that square wave inputs can also be handled.

So that the set can operate at 80V, 115V, and 240V at frequencies from 50-2000 c/s, the power transformer has been redesigned.

Lastly, a standard logarithmic variable attenuator has been added, so that besides a fixed output, a signal generator type variable output is obtained from the R.F. Oscillator.

3.2 Installation and Testing

3.20 - Introduction

with
This section deals with the installation of the station and the necessary testing before the station is in running operation. The actual mechanical installation is only described briefly as this section will be covered by the N.S.W. G. Railways.

The testing gear necessary are:-

- 1) standard impedance measuring gear, with trombone matching section,
- 2) phase checking set
- 3) AW Test Set (A-18/1)
- 4) Echo box

The latter two are standard items that go with the station.

3.21 Installation

The hut is put up in the normal AW fashion. The aerial comes in 8 bays, (each bay complete with dipole elements and $\lambda/2$ tributary feeders) plus structural members, mast and horizontal and vertical feeders.

In erection, the lower half is first assembled on the ground out of the four lower bays, the units being fitted round the mast structure. The horizontal feeders are strung and soldered, with the special 200W soldering irons to the tributary feeders. A special jib crane is then mounted on top of the hut and using this, the lower half is swung up on top of the hut and the portion of mast in the aerial section bolted to the portion of mast in the hut.

The upper half of the aerial is now assembled in a similar fashion to the lower. The jib crane is now mounted on top of the lower half and is then used to swing the upper

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half on top of the lower half of the aerial. The two halves are now bolted together.

The four vertical feeders are now strung up together with the four connecting feeders which attach to the centres of the four horizontal feeders. The four phasing switches are then mounted on the aerial and all $\lambda/4$ connecting feeders attached. Finally the monitoring cables and BL4 aeriels are mounted and cables run. The aerial is now in a state to be tested.

Meanwhile the radar equipment has been placed in the hut, the echo box and AV test set mounting on top of the BL4 set. R.F. cables are run and the Inner and Outer feeds attached to the Inner and Outer vertical parallel feeders by their trombone connections. Care must be taken that the two trombones connections are attached correctly, the cable side for the Outer being the righthand side and the cable side for the "Inner" being also the right hand side. Lastly the phasing cable is run from the four phasing switches down the aerial mast to the receiver cable and connection made to the terminals on the Gain Control Panel.

3.22 Matching Aerial

Once the aerial is up, the feeders run, and the relays of the phasing switch is connected, matching can start on the aerial.

The equipment required is the standard impedance measuring gear plus about 30' of UR1 cable ending in a trombone transformer to transfer from the coaxial to the parallel feeder.

The procedure is to match the input to each bay to the line impedance (330Ω) by adjusting the position and value of the stub on the short feeders connecting to the vertical feeders. All this is done in the "Phase" position.

To do this, the impedance gear is first lined up at 200 Mc/s and the length of cable to the trombone transformer adjusted to a multiple number of $\lambda/2$'s ($\pm 10^\circ$ is accuracy enough).

Referring to Dwg. B6748, the $\lambda/4$ lengths of 7/16" dia feeder are removed, the trombone is taken to position b, and a shorting bar placed a $\lambda/4$ ($14\frac{3}{4}$ ") below b along the feeder. The stub position and magnitude at q is then adjusted till the impedance gear reads 85Ω . This should mean that the top bay is matched. The lowest bay is now matched in a similar fashion, the shorting bay being placed a $\lambda/4$ above position b.

When this has been done and the 7/16" dia feeder connected, the Outer feeder system should be matched.

The top Inner bay is now matched by placing the trombone at b' and placing the shorting $\lambda/4$ below it. This time the connecting piece D has to be removed. The stub is altered as before for a match and then the process repeated for the lower Inner bay. For this latter, the connecting feeder is replaced and the shorting bar shifted $\lambda/4$ above point b'.

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On replacing the 7/16" dia feeder, the Inner feeder system should be matched.

This finishes the matching up of the array. The take-off from the Inner and the Outer feeders coming through the roof into the hut is now matched to the coaxial cable. The impedance gear is connected to the Outer feeder via trombone E and the position of attachment and of shorting bar adjusted till the impedance reading at r is 75Ω . To do this easily, the length of cable from impedance gear to trombone should be a multiple of $\lambda/2$.

Having adjusted the Outer, the Inner trombone F is dealt with.

This concludes the aerial and feeder matching.

3.23 Aligning Beam Switching Unit

Having completed the aerial and feeder matching, the next step is to align the beam Switching Unit. The equipment necessary is the standard Impedance Measuring Gear. The following procedure is then adopted (Dwg. B6985):-

1) Adjustment of L_0

The Beam Switching Unit is connected up correctly to the aerial feeders and the connection F in the Beam Switching Unit disconnected.

The Impedance gear is then connected at F to the Outer feeder system and the capacity plates rotated to the Inner position. The variable line L_0 is then adjusted till the impedance at A is resistive. The value should be 75Ω but due to variation in the line characteristic, may vary from 70-80 Ω . If it is not within 1 db of 75Ω the trombone on the Outer parallel feeder on the mast should be adjusted slightly till it is so.

2) Adjustment of C_0

Having adjusted L_0 , the F.I. Receiver is disconnected from the impedance gear and connected on to the Outer lead from the Beam Switching Unit by disconnecting at K. The connection A is reconnected and the impedance gear connected to the input to the Beam Switching Unit G (marked To Phase Changer). The oscillator of the Impedance Gear is then switched on and the reading noted on the F.I.R. The capacity plates are then rotated to the Broad position and the capacity stator plate meshing adjusted till the reading is a minimum. This reading should be at least 30 db down on the previous reading. The locking nuts on the sliding platform should then be locked.

3) Adjustment of L_I

The F.I.R. is reconnected to the Impedance gear, and the Beam Switching Outer reconnected to the Outer vertical feeder. With the capacity plates still on "Broad", the impedance at D is then adjusted to a resistive value by altering L_I . This value should be $75 \Omega \pm 1$ db.

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4) Adjustment of C_I

With the same impedance gear set up, the capacity plates are rotated to "Narrow" and the length of the variable line BD and the value of C_I (meshing of the stator plates) adjusted till the impedance is the same as for the "Broad" position. When this is fairly close, the capacity plates should be changed to "Broad" and the impedance noted again, as the adjustment of the variable line may change the impedance slightly. The position is then changed back to "Narrow" and finer adjustments made. This adjustment should be carefully done and the two values, "Broad" and "Narrow" should agree within 1%.

Having done all this in "Phase", the switch should be changed to "Antiphase" and the impedance values noted for "Broad" and "Narrow". Those should be within 2 db of the "Phase" value.

The locking nuts on C_I should then be tightened.

3.24 Phase Checking

This system is to make sure that all the four bays are fed correctly as regards phase, i.e., all equally phased when switch is in "Phase" and the top two bays out of phase in regard to the lower two bays when in "Antiphase".

The schematic of the method is shown in Dwg.D8458 and the equipment is seen to consist of:-

- i) Phase Checking Loop
- ii) Phase Changer
- iii) AW Test Set
- iv) F.I. Receiver
- v) Star Connection
- vi) 30' length of cable
- vii) Two of the monitoring cables

The components with the exception of the test set and F.I.R. all come in a kit called the Phase Checking Set. The Phase Changer is later installed on the side of the Receiver Cubicle.

On referring to the schematic, it is seen that the fixed output of the test set is connected to the aerial via the Beam Switching Unit. With the "Phase" working and capacity plates on "Narrow" this means that all the bays should be fed equally in phase and amplitude. The phase checking loop is attached to a certain definite position X on one of the bays and picks up a certain voltage thence feeding this via the 30' of cable down to the star connection. Thus at its junction O there will be a certain amplitude and phase of pick up signal. Now, joined to the second feeder of the star connection is the phase changer and the variable output of the test set. Thus into this second feeder is fed a voltage which is variable in amplitude and phase. If this output is adjusted to be equal in amplitude to the voltage from the phase checking loop and opposite in phase at O then will be zero voltage at O (a minimum in practice). This can

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be shown by connecting the third feeder to the F.I. Receiver. The position of the phase changer when there is this minimum is thus an indication of the phase of the pick up voltage at X. If now the phase checking loop is moved to an identical position on another bay and the phase changer adjusted once again for a minimum then the difference of the two readings should be the difference in phase between the two bays.

In practice then, the following procedure is adopted:-

- i) AW Test set fixed output connected to phase changer and thence to aerial via Beam Switching Unit. (This alters the position of the phase changer from that above but makes no difference to the theory). Capacity plates put to "Narrow" and switch to "Phase".
 - ii) Star connection joined to variable output of test set, to F.I.R. and to 30' cable plus phase checking loop.
 - iii) Phase checking loop placed from behind in left position of No.1 Bay (bottom). (There are two positions, left and right in each bay, marked by white paint). Pick up voltage measured on F.I.R. by disconnecting star connection at A.
 - iv) Connection A reconnected and B disconnected; variable attenuator adjusted till input to F.I.R. is equal to pick up voltage.
 - v) B reconnected and phase changer varied for a minimum. As the variation of this is only 200° it may happen that no minimum can be achieved (they occur every λ). In that case, reverse phase checking loop. Obtain a deep minimum by readjusting the variable attenuator and then record reading of phase changer, marking it 1L.
 - vi) Repeat all the above with phase checking loop placed in right hand position of No.1 Bay. This should agree within a few degrees with 1L.
 - vii) Now obtain phase angles of 2L, 2R, 3L, 3R and 4L and 4R. Normally it will be found that 1L, 1R, 4L and 4R are all about the same and likewise 2L, 2R, 3L and 3R, while there is a small difference, say 10° , between the two sets. This difference can be made good by cutting off a 10° length of the appropriate coaxial feeder, Inner or Outer, running from the Beam Switching Unit to the vertical feeders. If the Inner set readings are greater than the Outer set readings then it means that the Outer feeder is the one to cut and vice versa.
- If the discrepancy between 1 and 4 bays is greater than 10° or between 2 and 3 bays is greater than 5° then the vertical feeder system should be examined closely for anything wrong.
- viii) The "Antiphase" system can now be checked by obtaining a reading on No.4 Bay for "Phase" and then switching to "Anti-phase" at the same time reversing the phase checking loop. The new reading should agree with the "Phase" one within a few degrees. This test should be repeated with No.3 bay.

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ix) As a final check, if the coaxial feeder has had to be cut at all, the Beam Switching Unit should be realigned and another phase check done. The aerial should now be properly phased.

3.25 Adjustment of Monitoring Dipole

With the aerial matched and phased and the Beam Switching Unit aligned, the position of the monitoring dipole from the mesh reflector should be adjusted till the pick up as fed to the F.I. Receiver is 30 db down on the input from the Test set to the aerial via the Beam Switching Unit in position "Narrow".

3.26 Adjustment of Synchronising Motor

To make sure that when the transmitter pulses, the capacity plates of the Beam Switching Unit are in their mid position of meshing, the whole equipment is set in operation and the pick up from the monitoring dipole is fed to a neon bulb causing it to glow with each transmitter pulse. This neon bulb is then held close to the end of the shaft of the Beam Switching Unit and by a stroboscopic action, the position of the locating pen can be seen quite clearly. The Beam Switching motor is then rotated in its cradle, by loosening the securing bolts, until the position of the locating pen is correct for the full meshing of the capacity plates.

3.27 Use of Echo Box as Wavemeter

For all this testing and subsequent operation, it is essential that the equipment is working at correct frequency. To ensure this, the Echo Box can be used in the following manner.

For test equipment, normally CW, the output from the oscillator etc., is fed to one of the connections to the Echo Box and the other connection joined to the F.I. Receiver. The micrometer head of the echo box is then rotated slowly till resonance is achieved (maximum signal on F.I. Receiver). If this reading does not correspond to the correct frequency, then the oscillator tuning must be adjusted.

As this instrument is a very accurate one (bandwidth ± 30 Kc/s) one either requires to know roughly what the oscillator frequency is (within about 2 Mc/s) or else have a large input so that there is a reading on the F.I.R. even though well off resonance.

For checking the transmitter frequency, the monitoring dipole is joined to the Echo Box and thence to the VTVM of the test set. On maximising the reading, the frequency is again determined.

3.28 Adjustment of Phase Changer

It has been found necessary to provide a device such that the transmitter frequency is well within the band width

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of the AW receiver for both Phase and Antiphase working, Narrow & Broad. What happens in practice is that due to mutual coupling effects between bays, the impedance presented to the transmitter from the aerial on "Antiphase" is different to that on "Phase". This normally gives rise to a small difference in frequency, which can be serious on a narrow band receiver, such as the AW.

This difficulty is overcome by making use of the fact that in a tuned circuit, such as the output tuned circuit of a transmitter, a small change of resistance in the circuit will not change the resonant frequency appreciably but a similar small change in reactance will have a maximum effect. By using a variable $\lambda/2$ length of line, this change of impedance due to change of aerial working can be made of such a value that it does not affect the transmitter frequency appreciably.

This variable line is the Phase Changer which is mounted on the side of the Receiver cubicle and connects the Beam Switching Unit to the T-R Switch.

The process of adjustment is to measure the Transmitter frequency, using the Echo Box, test set and monitoring dipole as explained above, for every 10° of the Phase Changer and for both Phase and Antiphase working, the Beam Switching Unit being in the "Narrow" position. On drawing the two curves, Frequency versus Phase Changer angle for Phase and Antiphase respectively the position of intersection can quickly be determined and the Phase Changer set at it. This will mean that the frequency will be the same for Phase and Antiphase.

On turning to "Broad" the frequencies for "Phase" and "Antiphase" should both be within ± 5 divisions ($\pm 70\text{Kc}$) if the Beam Switch is correctly aligned.

3.29 Aligning T-R Switch

This TR switch is the coaxial type equivalent to the open parallel wire type. It has four tuning adjustments, two on each unit. The process of tuning up is as follows:-

- 1) Suppression - Connect the receiver lead from the TR Switch to the VTVM on the test set and then tune each of the screw driver adjustments (on end of tube nearest transmitter front) in turn for minimum suppression.
- 2) Reception - The receiver lead is reconnected to the receiver and a steady permanent echo picked out on the trace. Then each of the two vertical knobs are adjusted in turn for maximum height of echo.

3.3 Maintenance

3.30 Introduction

This section deals with periodic tests and other maintenance details special to the LW/AWH.

3.31 Daily Routine Maintenance

The following standard system of tests should be

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carried out in the period allotted to the daily routine maintenance:-

- (a) Monitoring Dipole Pickup - The feed from the monitoring dipole is connected to the VTVM of the test set and the voltage recorded for each of the positions "Narrow" and "Broad" of the Beam Switching Unit, "Phase" and "Antiphase".
- (b) Frequency - The monitoring dipole feed is transferred to the Echo Box and one of the monitoring cables used to connect the Echo Box to the VTVM. The frequency is determined for each of the four positions mentioned above.
- (c) Ringing Time (See below)
- (d) Suppression - Disconnecting the receiver feeder from the TR switch and using another of the monitoring cables, the suppression voltage from the TR switch is noted for one of the four positions (particular one is not important).
- (e) Ratio Dial Calibration -
 - (i) Using the third monitoring cable, the Signal Generator output of the test set is fed directly into the receiver. (when calibrating the ratio dial, the receiver should have been on for at least 15 minutes),
 - (ii) The transmitter H.T. is turned off.
 - (iii) The test set is switched to CW and Sig Gen and level of attenuator set at 40 db.
 - (iv) Ratio Dial is set to 65, switch set to "Height" and Beam Switching Unit to "Narrow".
 - (v) Meter on receiver set to "Detector" and receiver gain set to reading of .5 on meter, the test set output being tuned to the receiver working setting.
 - (vi) The ratio is set to 70 and test set attenuator setting increased till Detector current is again .5. Reading is seconded and process repeated for 75, 80, 85, 90, 95, 100, 110, 120, and 130 and then returning 120, 110, 100 etc. back to 65.
 - (vii) The Beam Switching Unit is set to "Broad" and the process repeated from 65 down to 0 and back again, starting once again at 40 db.
 - (viii) Calling the 40 db reading at 65 as 0 db and readings above 65 as + value (i.e., 95 may be + 5 db) and readings below 65 as - value, the Height Range Chart is calibrated, the Phase readings being written in black wax pencil and the Antiphase readings in

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red wax pencil. The 0 db readings will always be 65.

Besides doing this calibration each day, it should be repeated if the preamplifier requires retuning or a new valve.

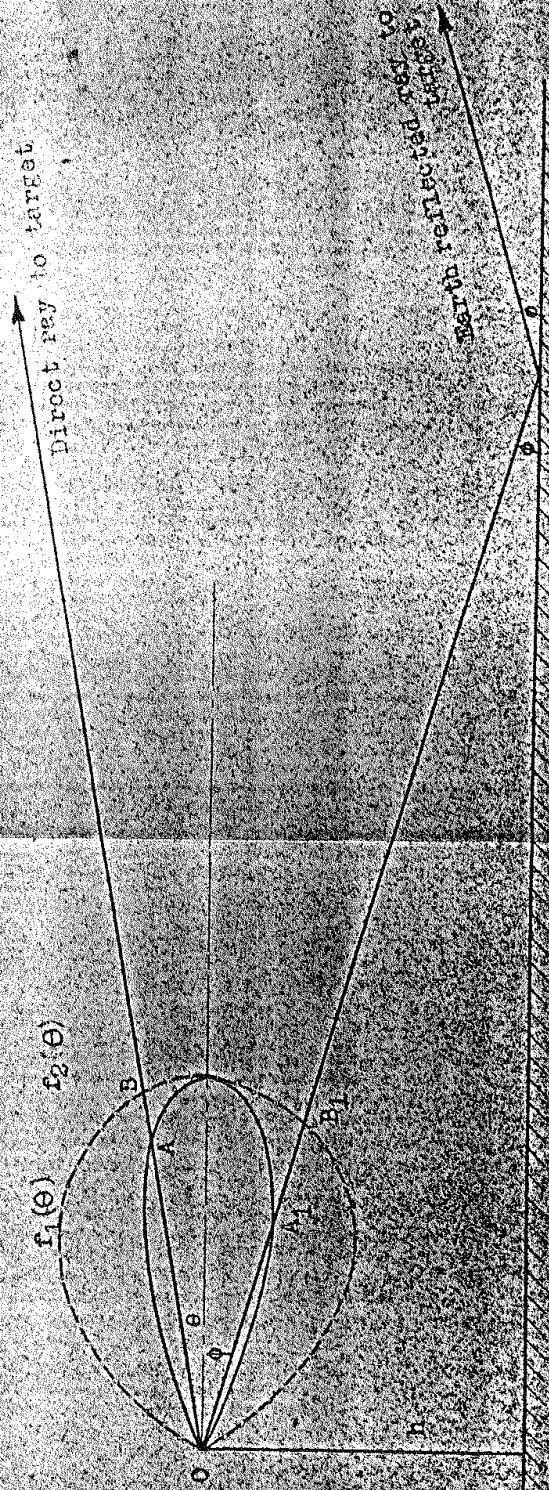
- (c) Ringing Time - With monitoring dipole still connected to the Echo Box, the other cable to the test set is disconnected and then the Echo Box tuned with the aerial system at "Antiphase" and "Narrow". This tuning is seen by a maximum length of the Echo Box pulse on the start of the AW trace. With a setting of about $\frac{1}{4}$ " of noise on the screen, the "length" of ringing time in miles is recorded.

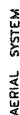
3.32 Other Maintenance Requirements

The aerial should be inspected in the normal fashion to see if there is any weathering or other deterioration, or if the feeders are too loose or tight.

The cams on the Beam Switching Unit should be greased about once each week and the motor oiled every three months. The capacity switch rotates in greased ball bearings which should be inspected every six months. The contacts should be examined for any sign of wear or cleaned if necessary.

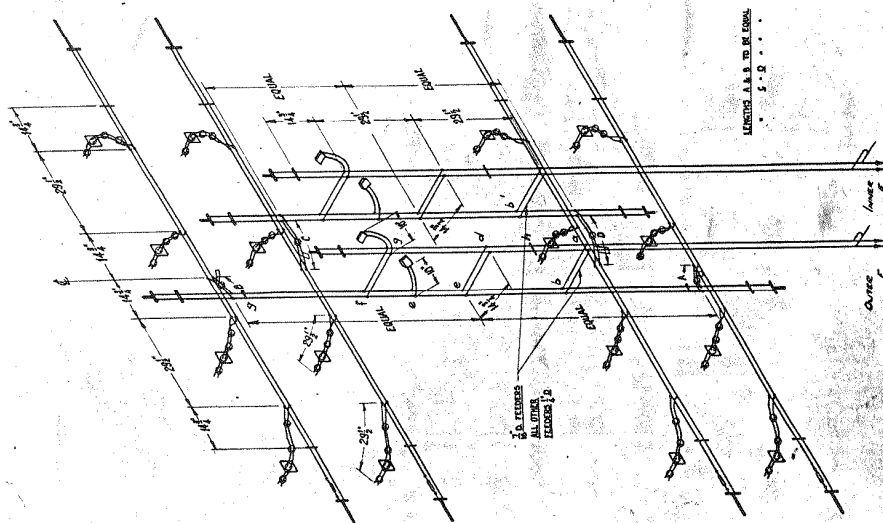
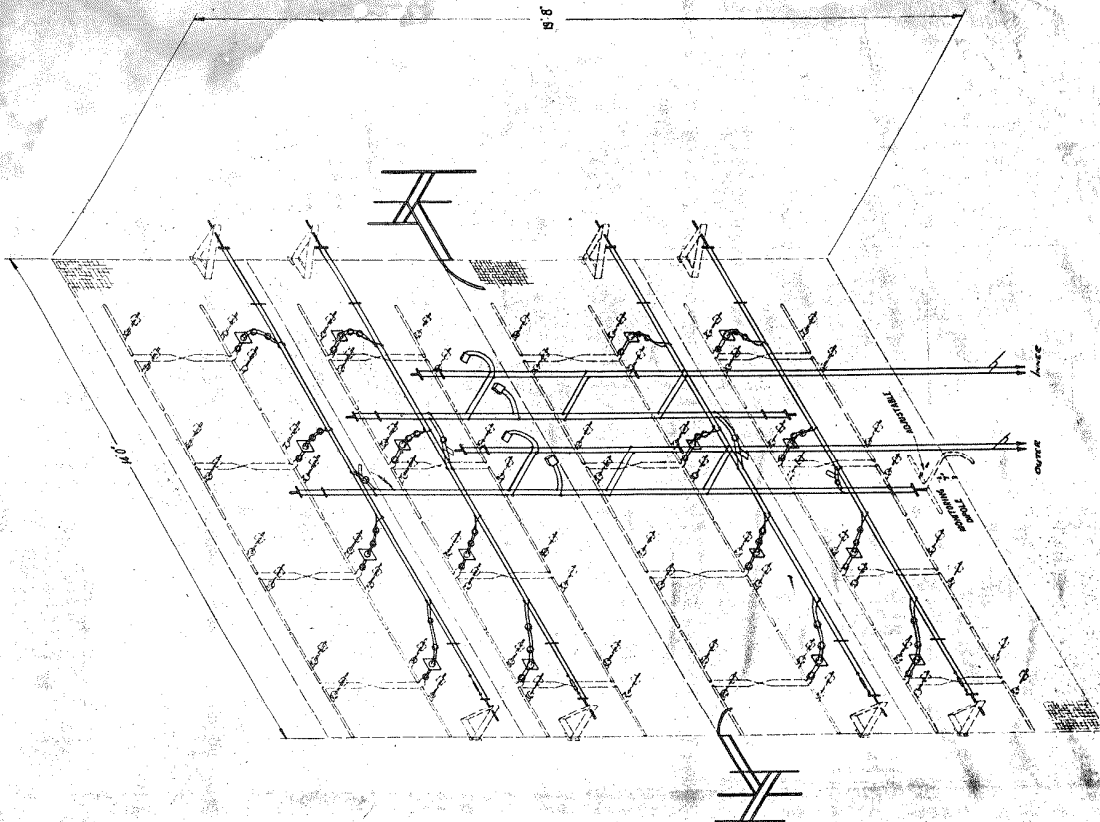
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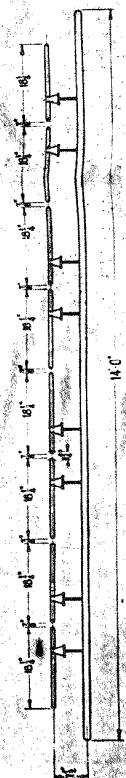
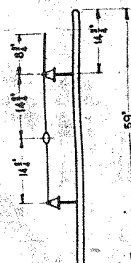
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REF	SECRET/NO TELL	NO. 1	UNIT	SERIAL
	SECRET/NO TELL		G.S.R.	RADIOGRAPHY LABORATORY
LW/AN/H				
PROPOSED AERIAL SCHEMATIC				
TITLE	DRAWING NO.	DATE	BY	CHECKED
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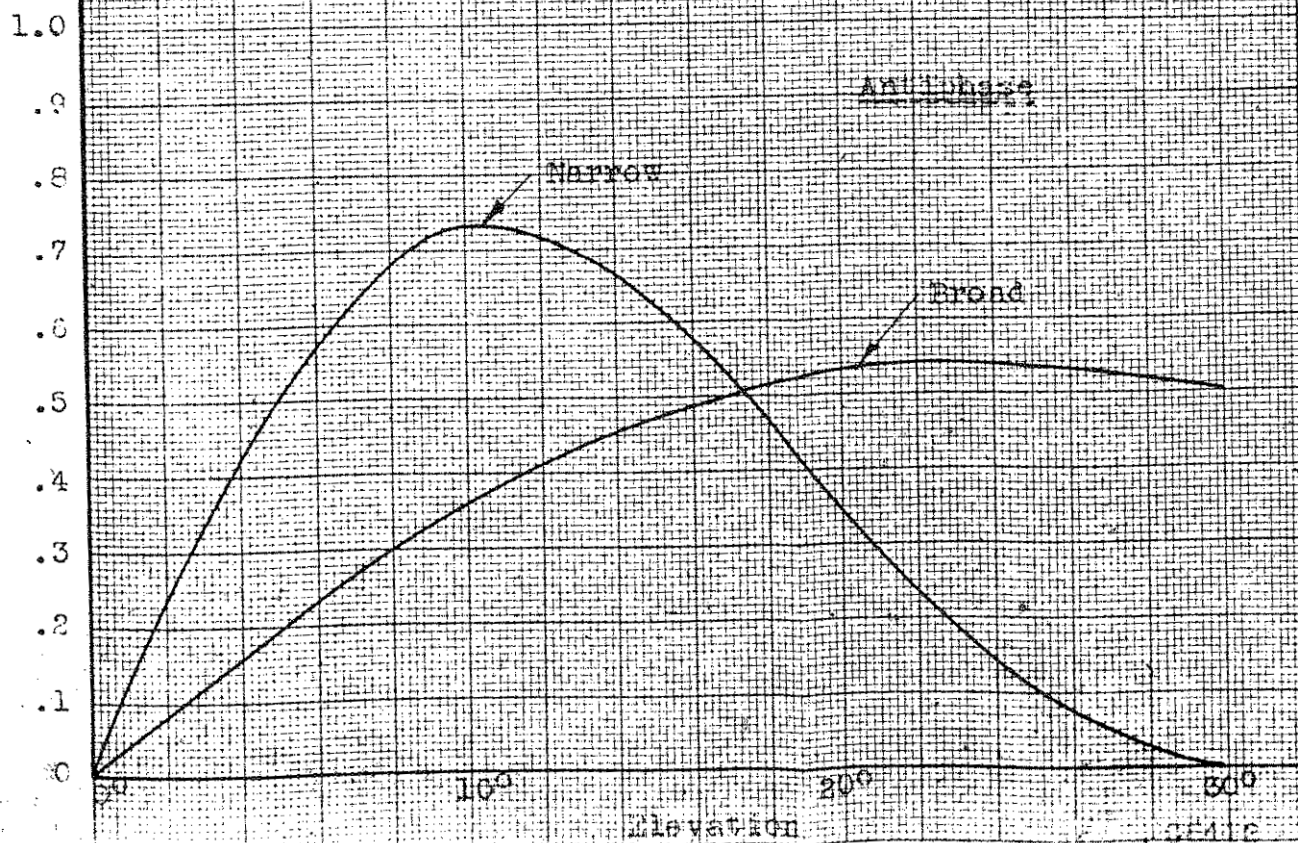
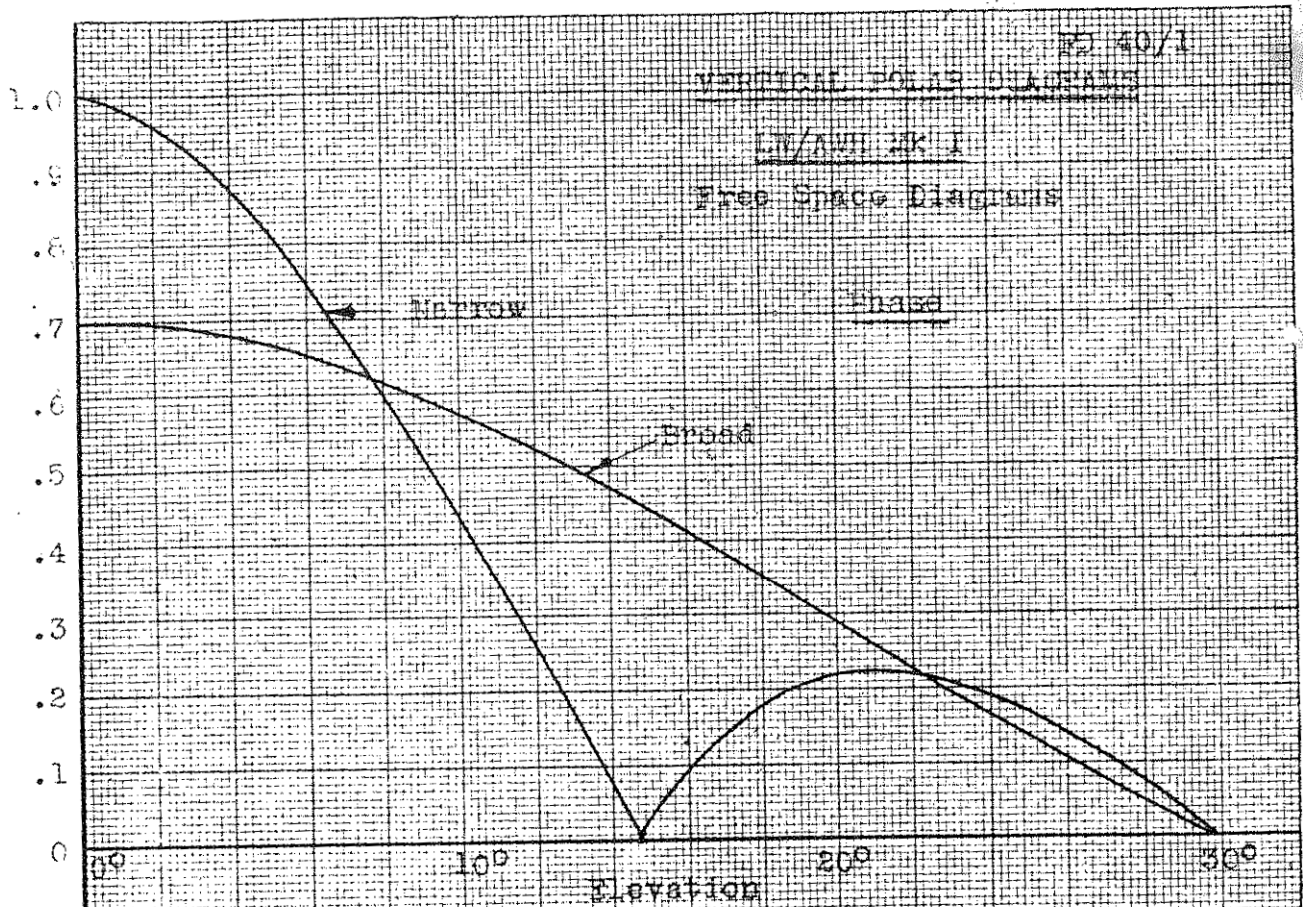
STRUCTURE & FITTING WHOLESALE FORECAST



VERTICAL POLAR DIAGRAMS

LN/ANTH MK I

Free Space Diagrams

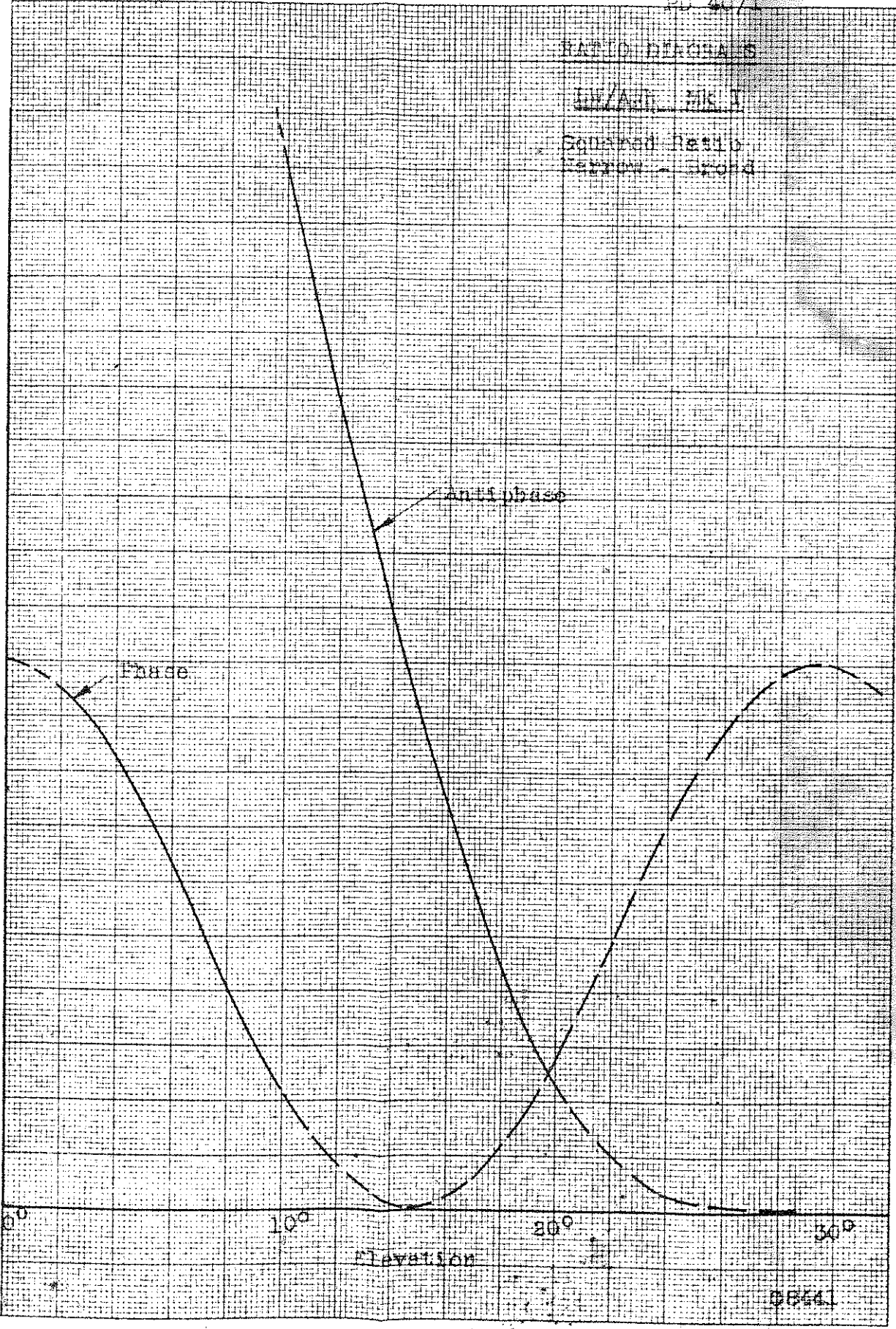


RATIO DIAGRAMS

IN/ANT. MK. I

General Ratio
Narrow - Broad

4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2



Elevation

08441

PD 4073

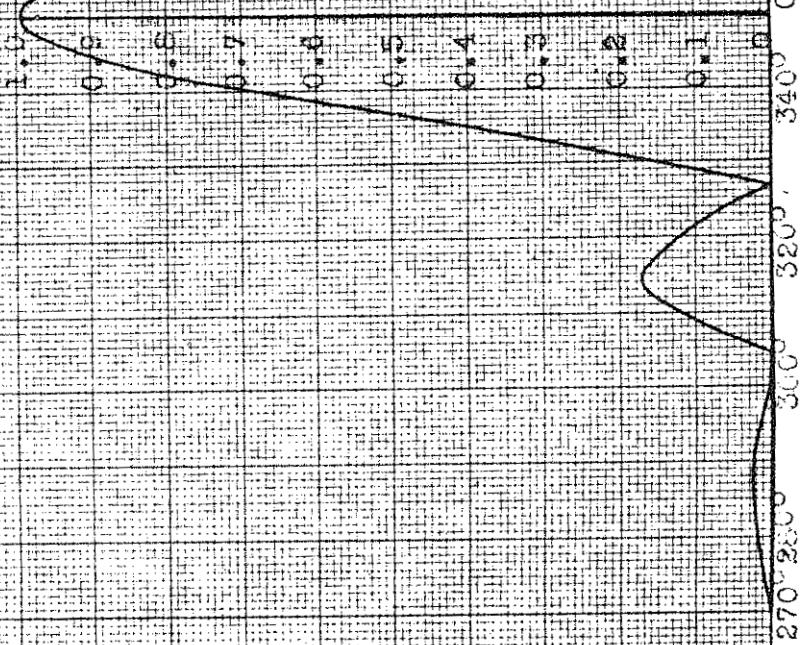
HORIZONTAL ANGLES PLOTTER

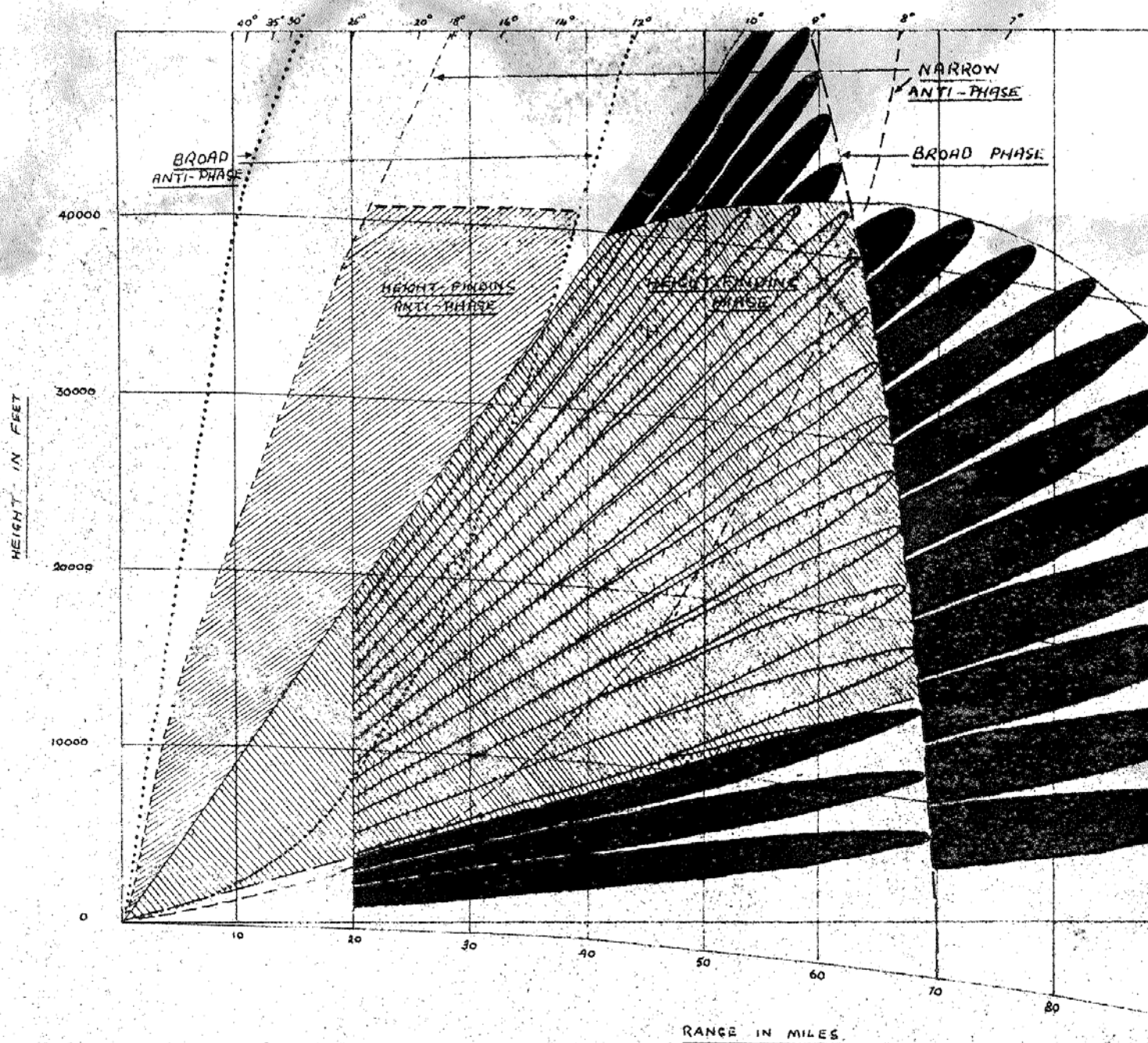
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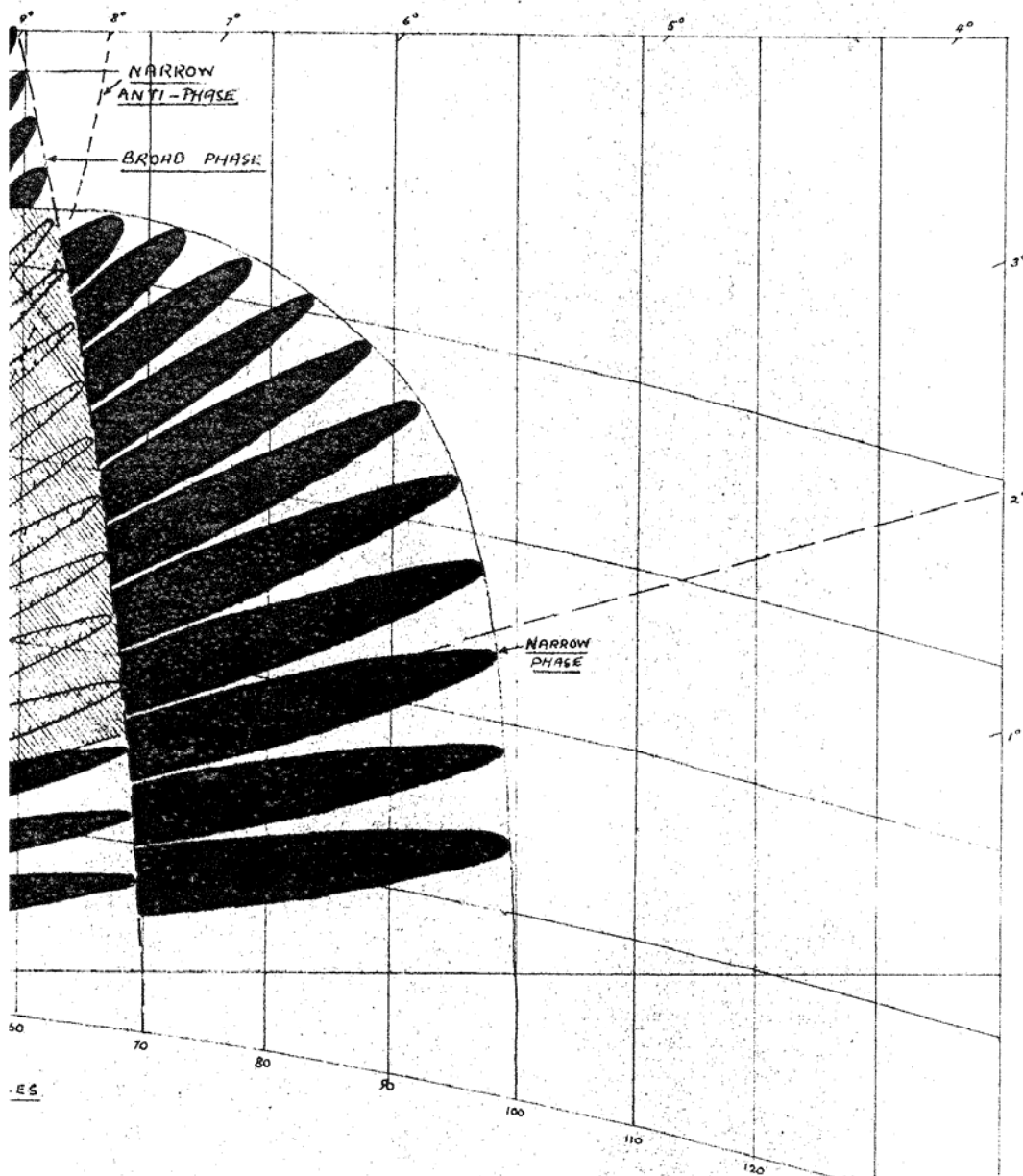
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0

68416

270° 260° 300° 320° 340° 0° 20° 40° 60° 80° 90°



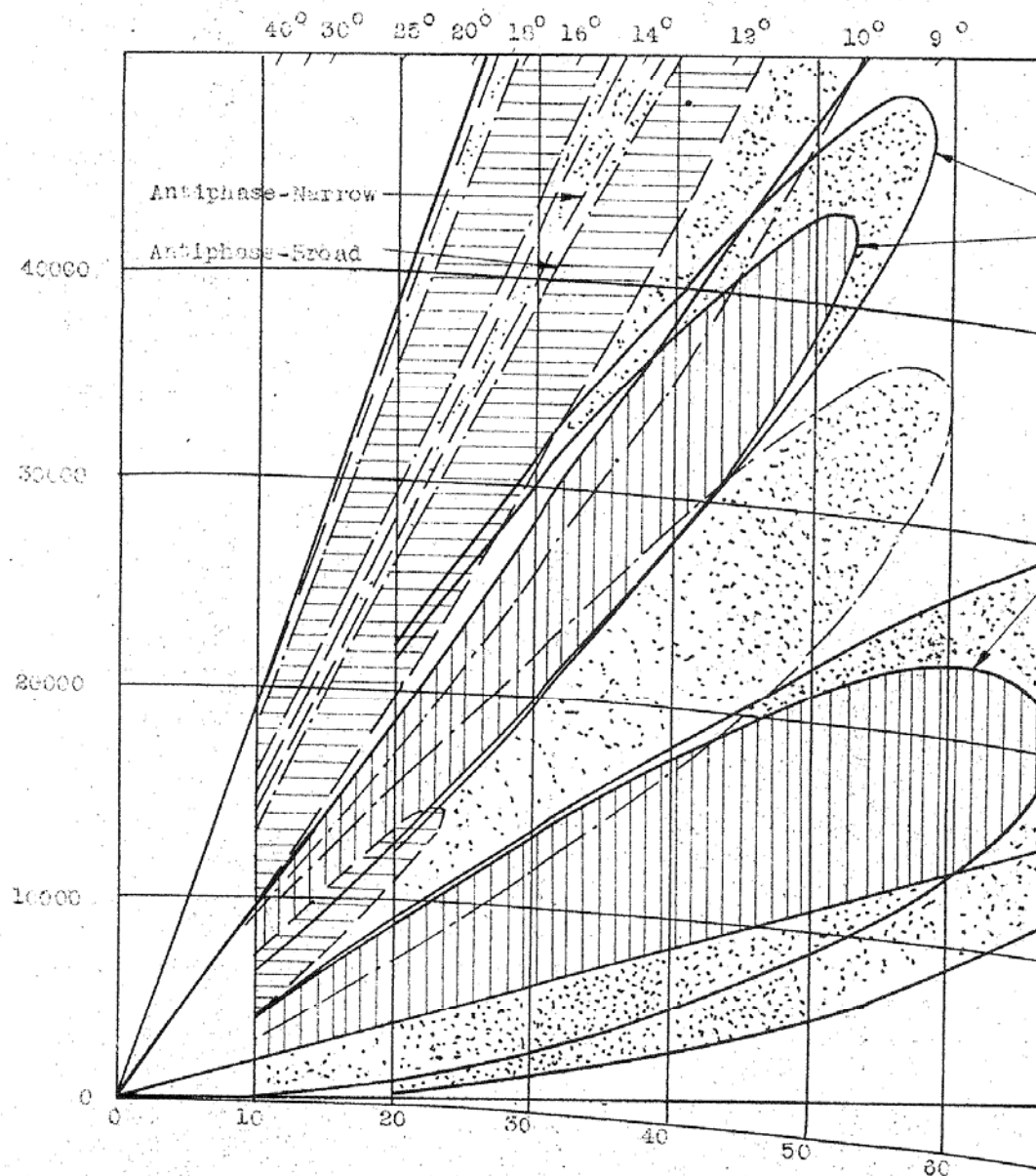
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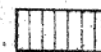
$K = 10,000$
 $F = 200 \text{ Mc/sec.}$
 $Ht = 250 \text{ ft.}$

ITEM	DESCRIPTION	QWC.	REQ'D	MATERIAL
C. S. I. R.				
RADIOPHYSICS LABORATORY				
VERTICAL AERIAL DIAGRAM DOUBLE BEAM HEIGHT FINDING SYSTEM				
SCALE		APPROVED		
PASSED	DRAWN	D 6853		A
DATE 15-2-44		CHECKED		

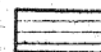
UNIT NO.	QWC.	ITEM	REQ'D



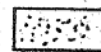
PLAN RANGE (Miles)



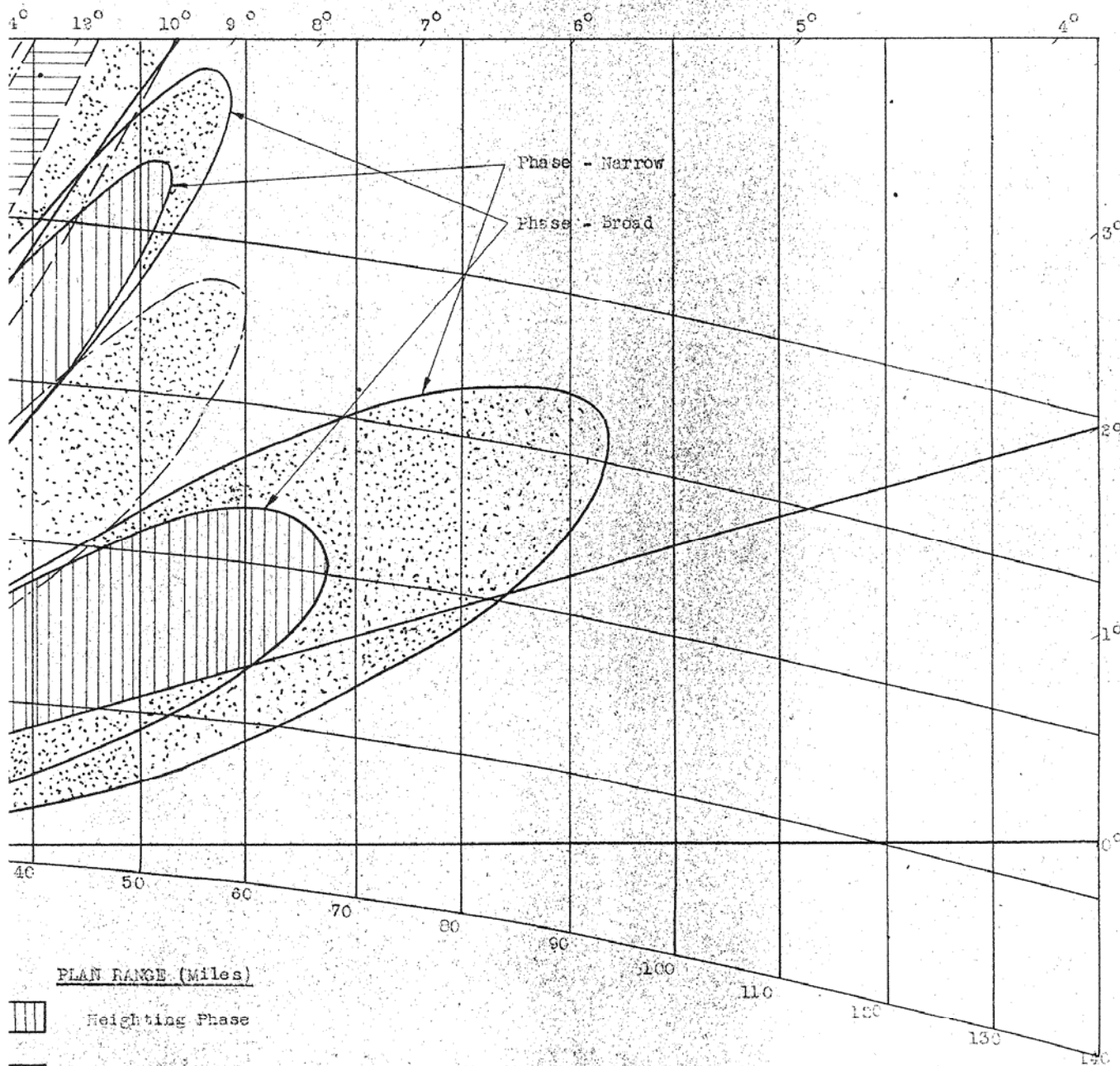
Heighting Phase



Heighting Antiphase



Air Warning



PLAN RANGE (Miles)



Heighting Phase



Heighting Antiphase



Air Warning

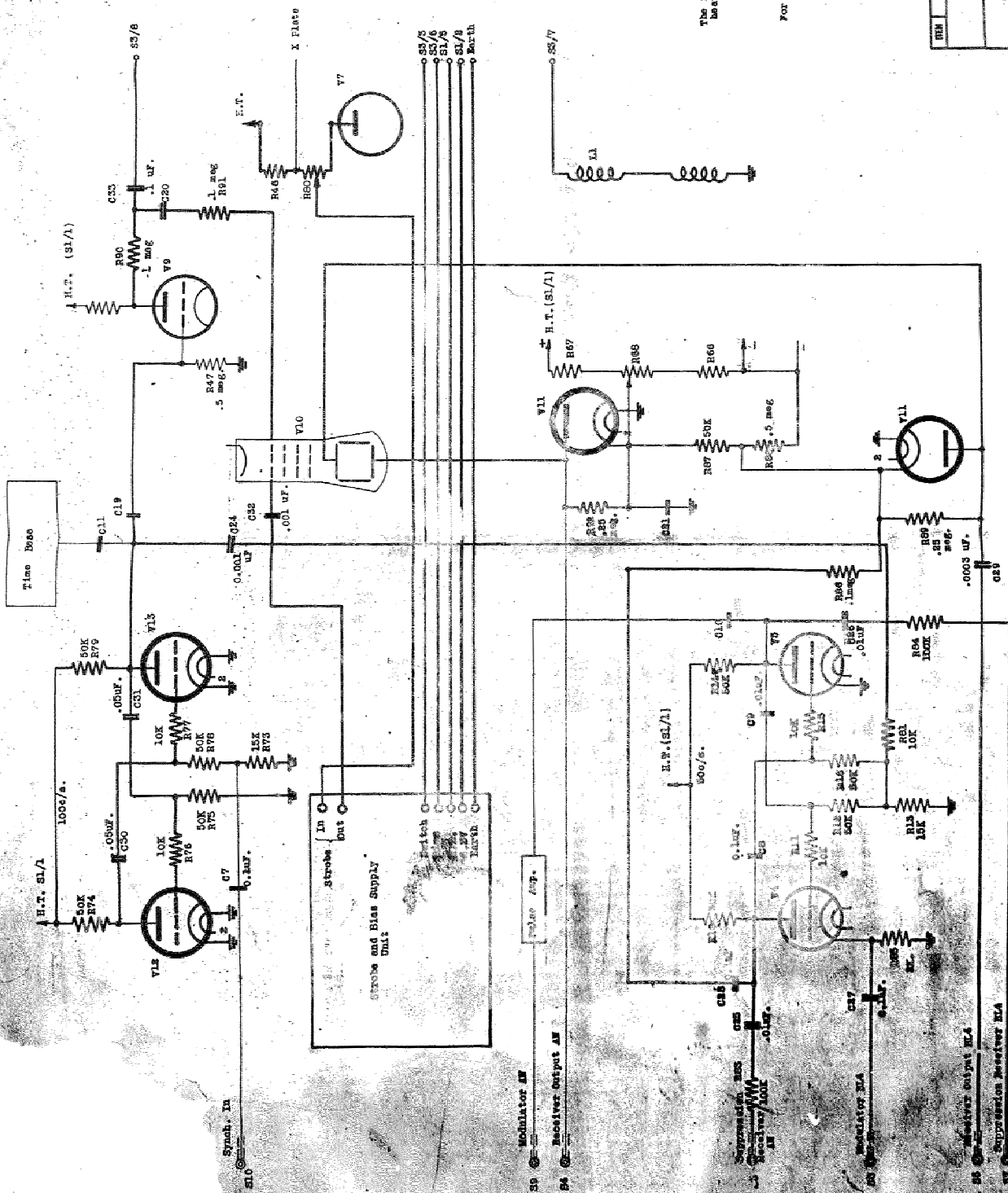
HEIGHT = 25 ft.

FREQUENCY = 200 Mc/s.

Assumed Range LW/AW Mk Ia = 70 miles

06440

COVERAGE DIAGRAM LW/AW Mk I



The following items are additional and are shown in heavy outline :-

0 25-33
12 and 13

0 25-33
12 and 13

0 25-33
12 and 13

For component Part 338 List No. 7430

ITEM	DESCRIPTION	DATE	MATERIAL
	C.S.I.R. RADIOPHYSICS LABORATORY		
	VIEWING UNIT SCHEMATIC		
	MODIFICATIONS TO H.M.V. UNIT U453/A		
SCALE	PASSED	APPROVED	
<i>McGowan</i>	7/1	C	7241
1.4.44	TRACED	B	
CHECKED			

RADIOPHYSICS

COMPONENT PARTS LIST

COMPILED R.F.B. LIST NO. 7672

APPROVED SHEET 1 OF 2 SHEETS

DATE 31/5/44

ISSUE A

ASSY. DWG. 7

C7673

DRAUGHTSMAN, GROUNDED GRID TYPE.

DESCRIPTION	MATERIAL	PART NO.	DWG. NO.	QTY. DWG. Item No.	SCHEMATIC DIAG. REF.	No. per UNIT	REMARKS	QUAN.
CHASSIS	MILD STEEL 20 S.G. 11 1/2" x 9"		C7674	1		1		
BASE	" " 8-1/16" x 11"		C7675	2		1		
SHIELD	" " 4 3/4" x 2 1/2"		C7676	3		2		
SPACER	LA.M. PHENOLIC ROD PAPER BASE		C7677	4		6		
	3/16" dia. x 5/16"							
SPACER	LA.M. PHENOLIC ROD PAPER BASE		C7678	5		4		
	1" dia. x 7/16"							
CLAMP VALVE, ANA EF50 type				6		2	P	
TERMINAL STRIP CERAMIC UCON S9C13	13" long 2 lugs			7		1	P	
" " " " "	2 3/4" " 8 "			8		1	P	
" " " " "	1 1/2" " 4 "			9		1	P	
SCOTCH TAPE EF50 TYPE				10		2	P	
GROMMET				11		1	P	
GROMMET				12		1	P	
EYELET, MICRO "R"				13		4	P	
SCREW, CSK. HD. 8 B.A. x 1/2"	BRASS, PLATED			14		6	P	
" RD. " 5 B.A. x 1/2"	" "			15		6	P	
" " " " x 3/16"	" "			16		4	P	
" " " " x 1/4"	" "			17		4	P	
" CSK. " " x 3/16"	" "			18		6	P	
NUT, HEX 8 B.A.	" "			19		6	P	
" " " "	" "			20		4	P	
WASHER FIBRE 5 B.A.				21		4	P	
" " " 8 B.A.				22		6	P	
" 5 B.A.				23		4	P	
CONDENSERS, 3-30 pF Ducon Trimmer	TS2-A				C12	1	P	
CONDENSER 1 1/2 - 7 pF, DUCON PRIMER	TS2A				C1	1	P	
" 100 pF, SINGLE MICR 400V. JKC.					C2, 3, 4, 5, 6	5	P	
" 2-30 pF, DUCON TRIMMER TS2 A					C7	1	P	
" 100 pF, SINGLE MICR 400V. JKC.					C8, 9, 10, 11, 12	4	P	

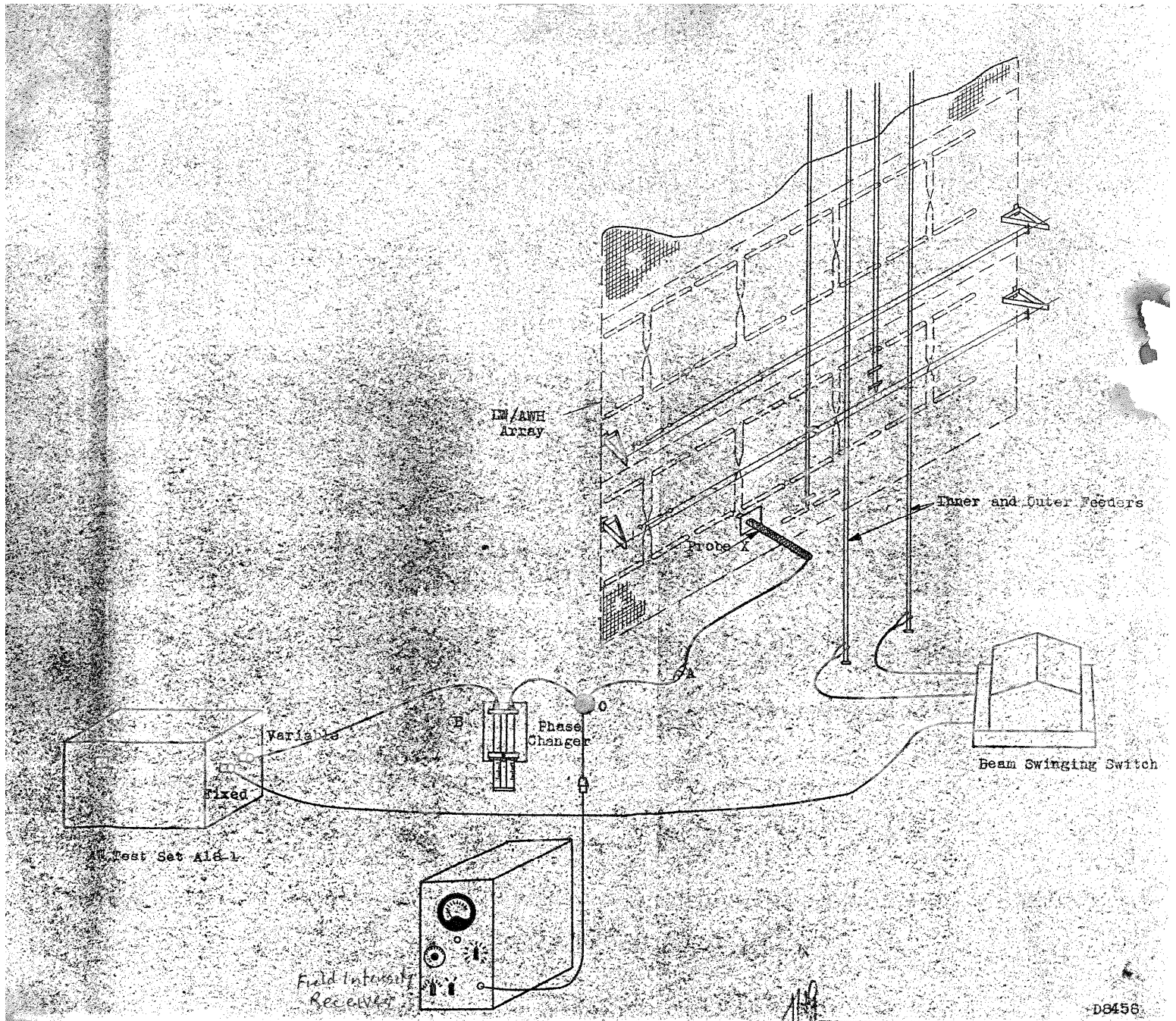
RADIO PHYSICS

COMPONENT PARTS LIST

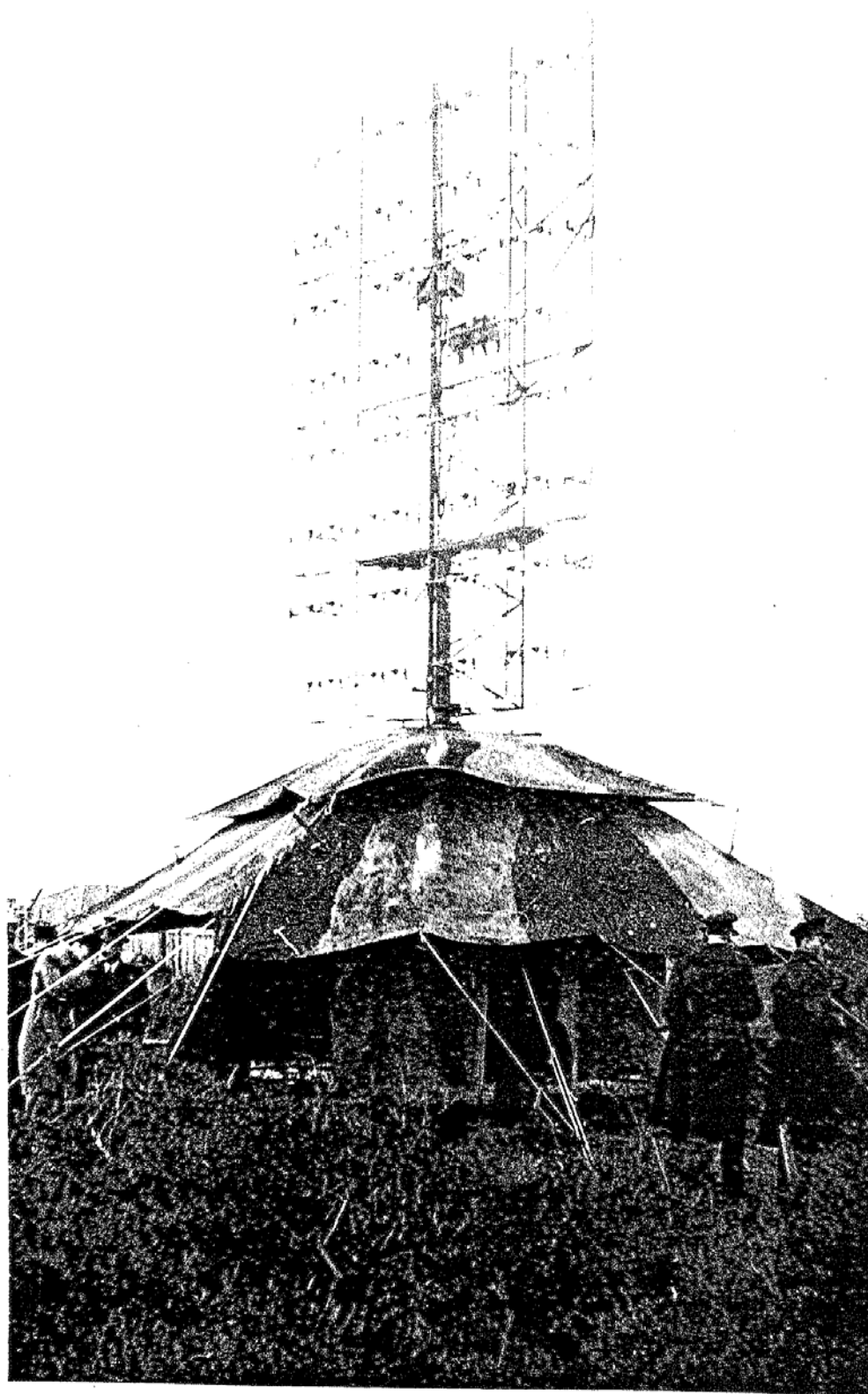
COMPILED R.P.B. LIST NO. 7872
 APPROVED SHEET 2 OF 2 SHEETS
 DATE 31/5/44 ISSUE A

ASSY. DWG. NO.
 67673

DESCRIPTION	MATERIAL	PART NO.	DWG. NO.	ASSY. DWG. NO.	SCHEMATIC DIAG. REF.	QTY. REQ.	REMARKS
RESISTORS							
RESISTOR 140 ohms. 1/3 Watt					R1	1 P	
" 5000 " 1 "					R2	1 P	
" 140 " 1/3 "					R3	1 P	
" 5000 " 1 "					R4	1 P	
INDUCTANCES							
CHOKE, R.F.					L1	1 M	
CHOKE, HEATER			P2223		L2	1 M	
CHOKE, R.F.			P2222		L3, L4, L5	3 M	
COIL, R.F.			P2225		L6	1 M	
COIL, COUPLING			67673		L7	1 M	
CHOKE, R.F.					L8	1 M	
CHOKE, HEATER			P2223		L9	1 M	
CHOKE, R.F.			P2222		L10, L11, L12	3 M	
COIL, R.F.			P2225		L13	1 M	
COIL, COUPLING			67673		L14	1 M	
					L15	1 M	
CONNECTORS							
CONTROLLER CHASSIS FOLIO					PL, P3	2 P	
PLUG & SOCKET AMPHENOL 3BS WITH LOCKWIRE					P3	1 P	
VALVE 6X37/CV66					V1, V2	2 P	



COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH
RADIOPHYSICS LABORATORY



DATE: August, 1944

REF: P.D. 40/1

NEG. No: 431/4

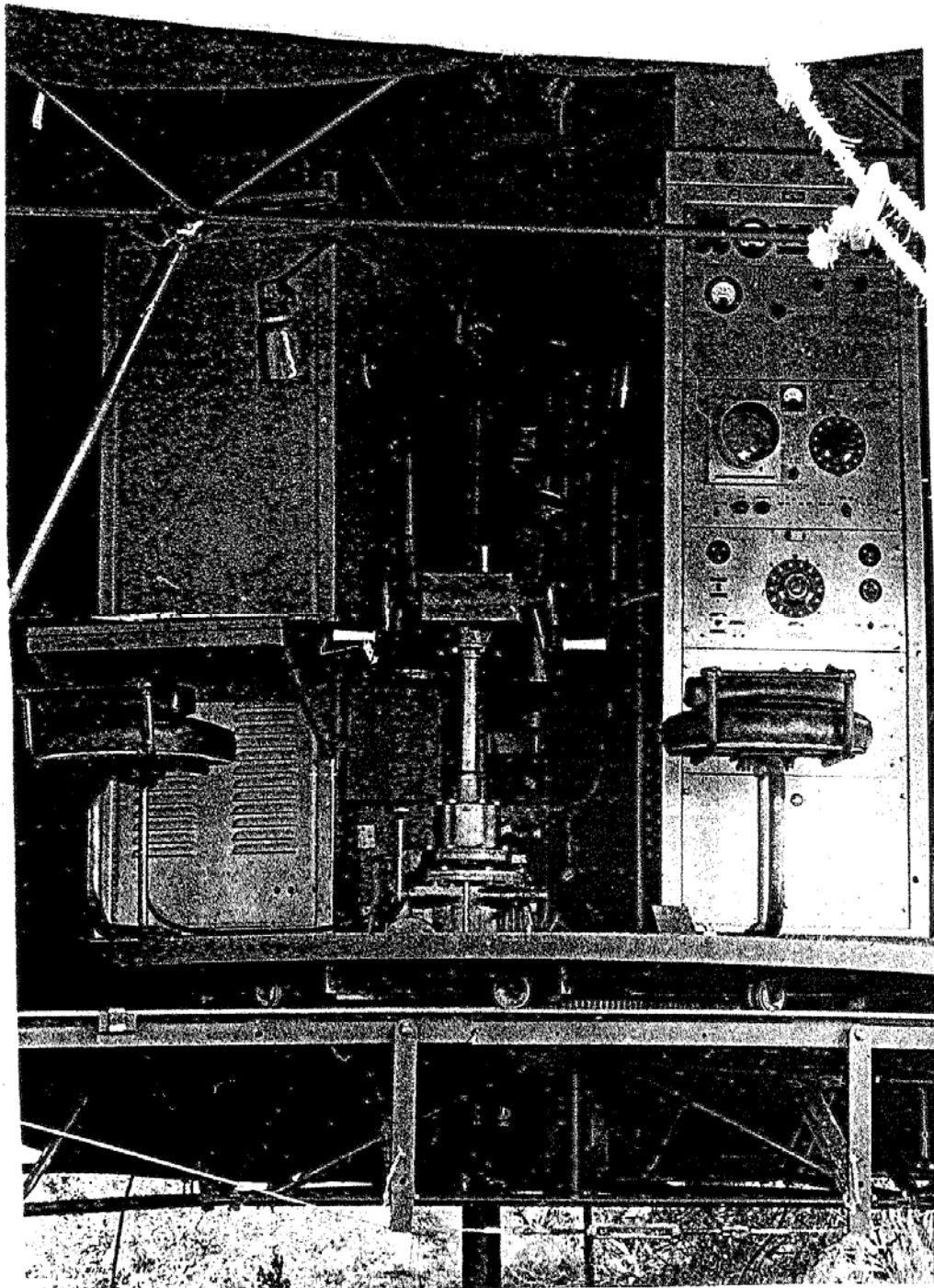
VIEW OF STATION

PLATE No: 1

J. H. G. ...

OFFICER IN CHARGE

RADIOPHYSICS LABORATORY



DATE: August, 1944

REF: P.D. 40/1

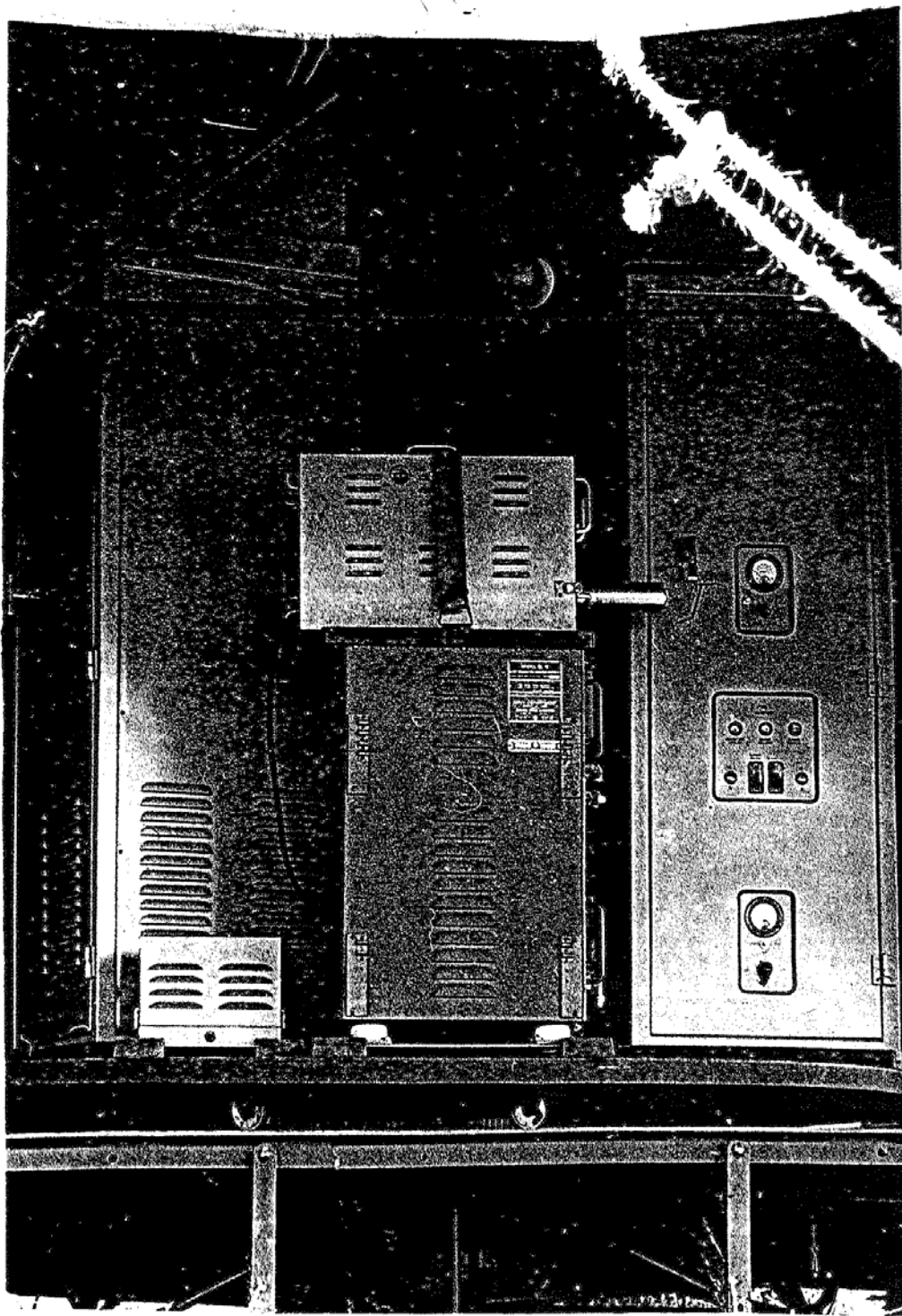
NEG. N2445/1/4

INSIDE HUT - RECEIVER SIDE

PLATE N2:2

[Signature]
OFFICER IN CHARGE

RADIOPHYSICS LABORATORY



DATE: August, 1944

REF: P.D. 40/1

NEG. NO: 445/1/4

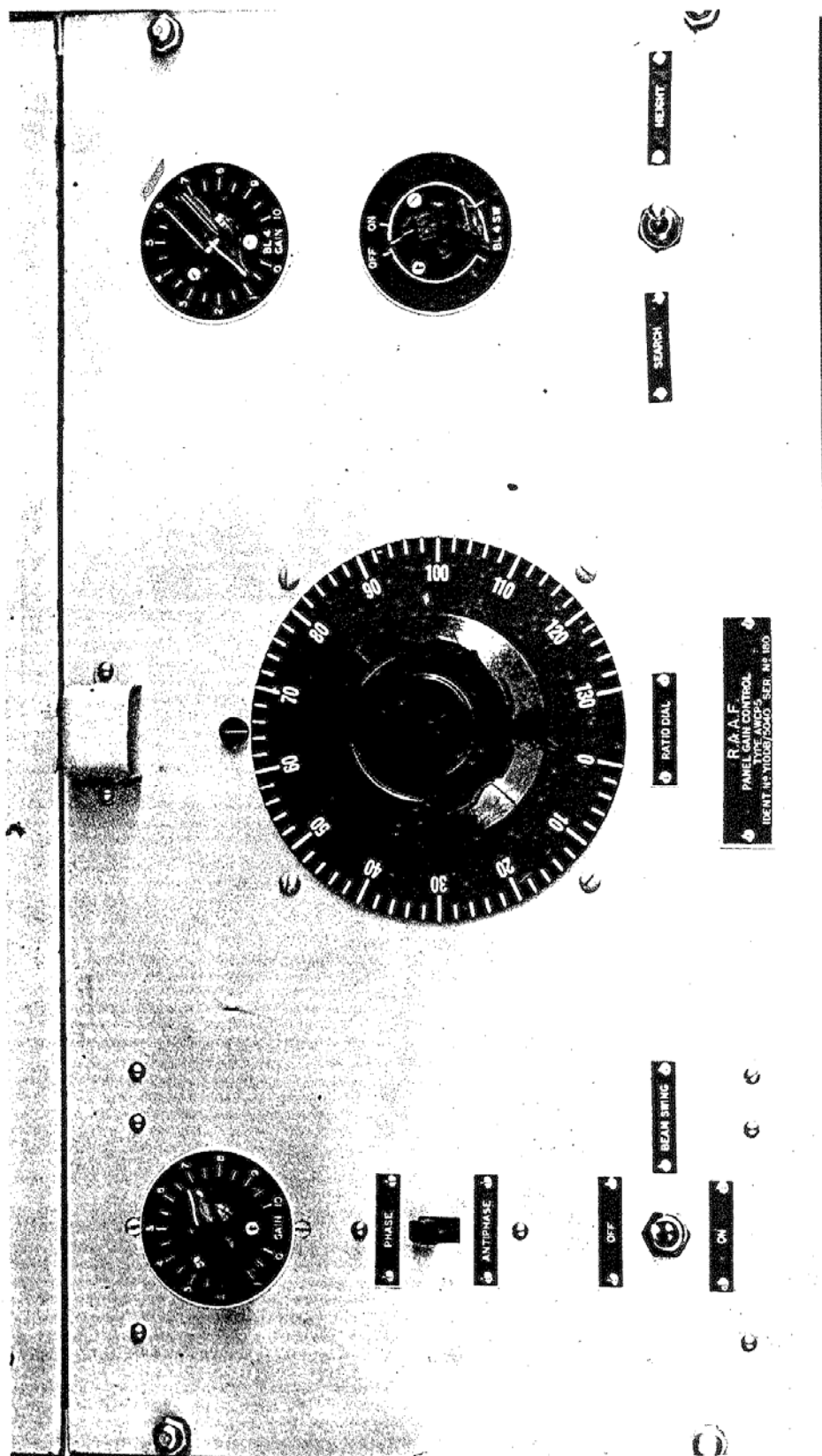
INSIDE HUT - TRANSMITTER SIDE

PLATE NO: 3

J. H. [Signature]

OFFICER IN CHARGE

RADIOPHYSICS LABORATORY



DATE: August, 1944

REF: P.D. 40/1

NEG. NO: 445/5

GAIN CONTROL PANEL

PLATE NO: 11

JH
OFFICER IN CHARGE

RADIOPHYSICS LABORATORY



DATE Dec., 1943

REF: P.D. 40/1

NEG. No: 355/1

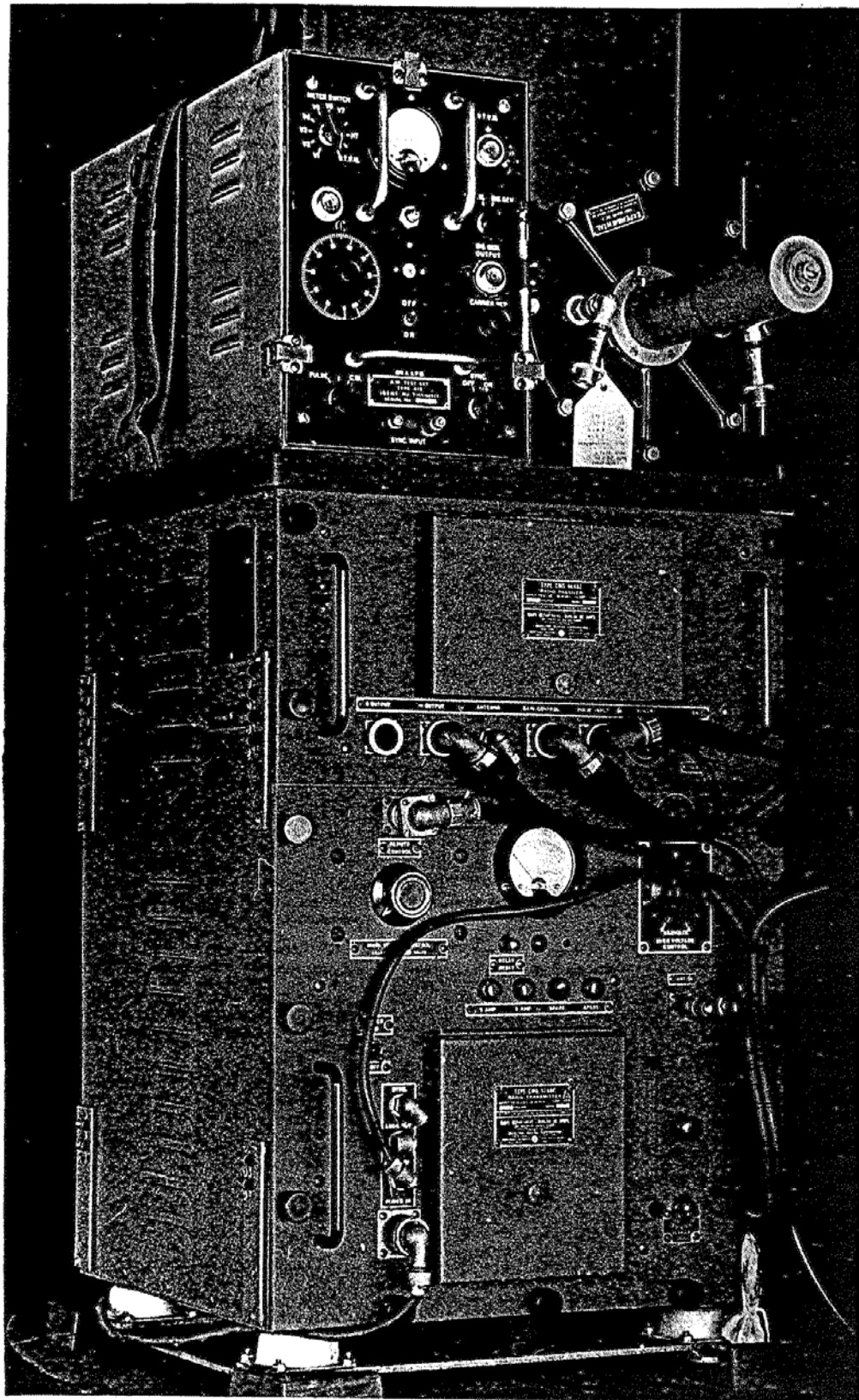
PAIR OF ECHOES

PLATE No: 5

J. H. Bessard

OFFICER IN CHARGE

RADIOPHYSICS LABORATORY



DATE August, 1944

REF: P.D. 40/1

NEG. NO: 445/5

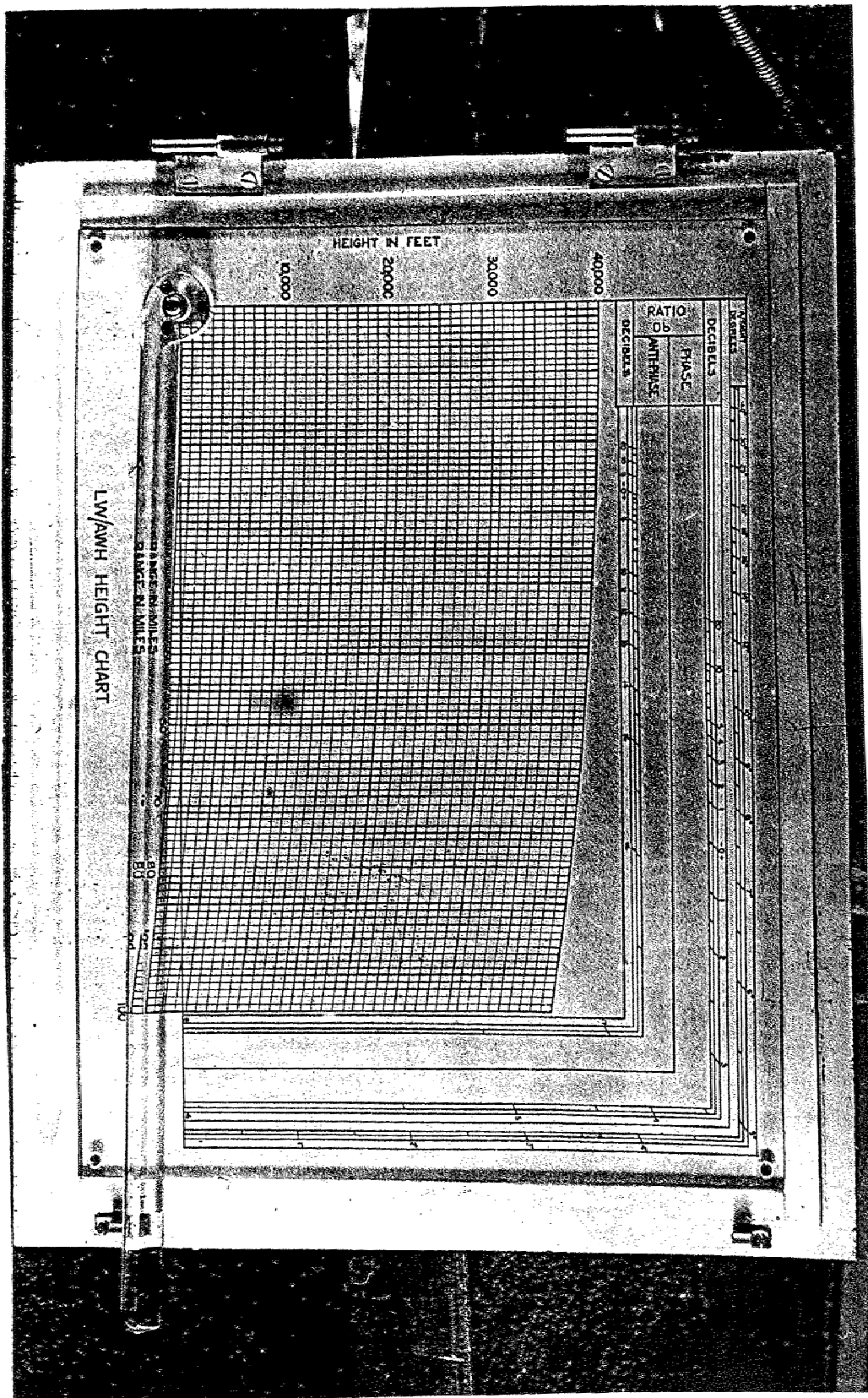
TEST EQUIPMENT

PLATE NO: 6

J. H. G. H. G.

OFFICER IN CHARGE

RADIOPHYSICS LABORATORY



DATE: August, 1944

REF: P.D. 40/1

NEG. NO: 445/2

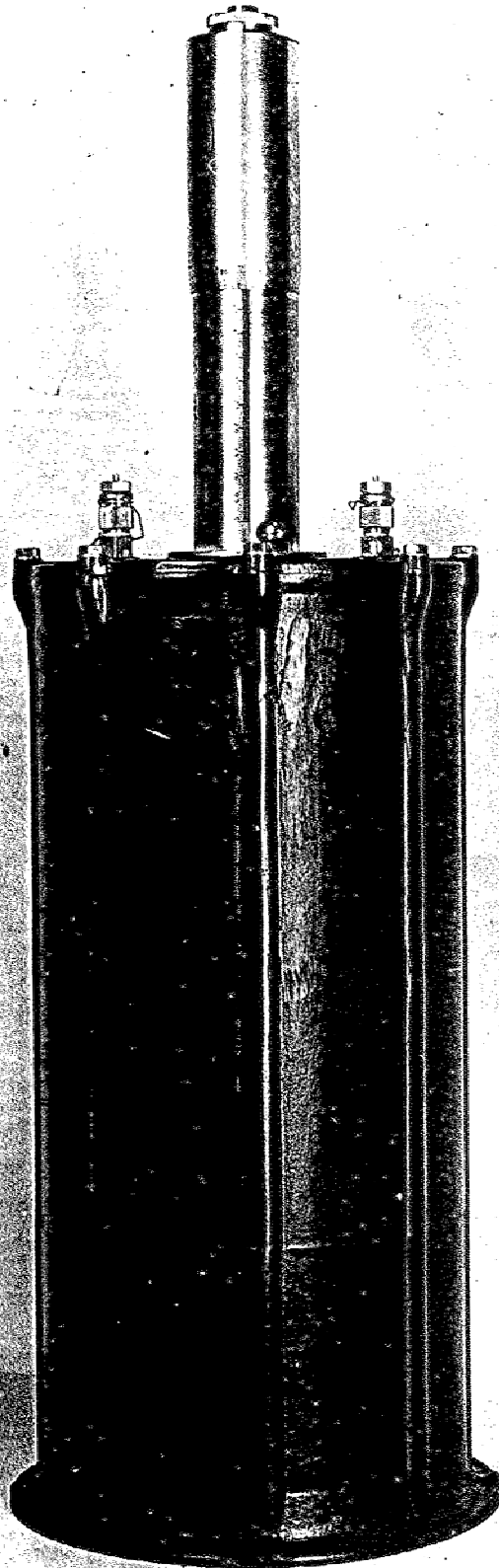
HEIGHT RANGE CHART

PLATE NO: 7

J. H. Harnard

OFFICER IN CHARGE

RADIOPHYSICS LABORATORY



DATE: August, 1944

REF: P.D. 40/1

NEG. NO: 424/2

ECHO BOX

PLATE NO: 8

W. L. S.
OFFICER IN CHARGE